BRITISH COLUMBIA PROVINCIAL MUSEUM
Department of Education

HANDBOOK No. 5

The Fresh-water Fishes of British Columbia

by

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DIRECTOR, BRITISH COLUMBIA PROVINCIAL MUSEUM,
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and

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Black and white illustrations by Frank L. Beebe

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Enjoy thy stream, O harmless fish;
And when an angler for his dish,
Through glutton's vile sinne,
Attempts, the wretche, to pull thee out,
God give thee strength, O gentle trout,
To pull the raskall in!

From *The Scottish Field*, January, 1945.

KAMLOOPS TROUT.

Salmo gairdnerii kamloops Jordan.

"Rainbow" coloration; a recently spawned fish.

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The Fresh-water Fishes of British Columbia.

INTRODUCTION.

Fishes comprise a group of animals which as a rule are easily distinguished from other similar animals because they possess several features that are easily recognized. Nevertheless, since it is occasionally difficult to decide if a certain creature is a fish or not, it is advisable to make clear in our minds just what a fish is.

Broadly stated, a fish is a cold-blooded vertebrate (an animal with a backbone) which lives in water, and possesses paired fins, gills, and usually scales. This definition rules out warm-blooded aquatic animals such as whales, porpoises, seals, etc., and also such cold-blooded animals as reptiles (which breathe by lungs and lack fins) and amphibians (which may have gills but no paired fins.) It also excludes lampreys, which are fish-like in both form and habits, but which lack paired fins. However, lampreys are usually included with fishes, as they are in this booklet, because they are commonly looked upon as fishes and are often treated as such.

Several species of fish, such as the Pacific salmon, eulachon, and shad, spend the greater part of their lives in the sea, going to fresh water for a short time only to spawn. These fishes are usually looked upon as marine species, but since they are found in rivers and lakes at some time during their life-history, they are included here with those fish which spend their entire lives in fresh water.

There are at least sixty-three different kinds (species and subspecies) of fishes in the fresh waters of British Columbia. Some, such as the salmon, are of great commercial importance; some, such as the trout and char, are of great interest to the sportsmen and indirectly of very considerable economic value; others, such as many of the minnows and "coarse" fish, are of no direct value, but may serve as food for other more valuable creatures; all are of importance in studying and measuring the wildlife resources of this Province. The purpose of this booklet is to acquaint the reader with the various

species known to occur in the lakes and rivers of this Province and to make available information concerning their distribution and life-history.

Fig. 1. Map of British Columbia showing principal drainage basins.

THE FISH'S ENVIRONMENT.

Fishes live in a world which is so different from ours that it is necessary to know something about it in order to understand them better. Water, which makes up the world of fishes, possesses many

characteristics which profoundly affect the structure and life of its inhabitants. Only a few of these properties can be briefly referred to here.

Buoyancy.—A body immersed in water is supported to a much greater degree than is a body in air. It is not necessary therefore for a fish to develop strong supporting structures, such as limbs in land animals. Furthermore, the specific gravity of the body of a fish is further decreased by the presence of fats and oils and, in some species, a swim bladder containing air, with the result that the weight of a fish just about equals the weight of the water displaced. Because of this, practically no effort is required in still water to remain in one position.

Viscosity.—Water tends to resist the movement of a body through it, and the amount of the resistance varies according to the shape of the body. Thus an object cylindrical in cross-section with a smooth surface, rounded in front and tapered behind, moves through the water with the least resistance. Fast-moving fishes tend to have bodies approaching this ideal shape and are said to be "stream-lined." The shape of a fish's body is therefore the result of the combined influence of two main factors—resistance of the water and swimming habits of the fish.

Refraction and Absorption of Light.—Beneath the surface of the water visibility is not quite as good as in air; rays of light are not able to travel as fast or as far. Much of the light is absorbed by particles of matter in suspension, therefore objects cannot be seen at so great a distance. Darkness increases with depth, but there is no distortion. When light rays pass at an angle from water to air or from air to water, however, they are bent, with the result that the object viewed appears to be where it is not. The apparent bending of a stick or paddle where it enters the water is a familiar example of this phenomenon, which is known as "refraction." Because of this and other peculiarities connected with light rays entering and leaving water, it is believed that the outside world is viewed by a fish as if through a circular skylight directly overhead, with objects or persons on the bank of the stream or shore of the lake appearing as if they were projecting inward from the circular horizon.

Temperature.—Water is a poor conductor of heat. When the surface of a lake becomes warmed in the spring, the temperature of the deeper portions remains almost unchanged, unless wind-storms mix the water. During the summer, therefore, only the upper layers of water become warmed to any appreciable extent, and the water tends to remain in layers, with the coldest (and consequently heaviest) layers or strata at the bottom. Under these conditions the maximum range in temperature of a lake may be from about 32° to about 65° F. In small lakes surface temperatures of about 70° F. may occasionally be found. A fish, being cold-blooded, takes on the temperature of the water in which it lives, and this can be regulated somewhat by seeking out a layer of water which is at the desired temperature. In the fall the surface water cools and mixes with the rest during the first wind-storm, so that in winter the whole lake is usually of the same temperature. If the lake freezes over, the uppermost layer of water beneath the ice may be close to the freezing-point; the deeper water, however, remains at about 4° above freezing, the temperature at which fresh water has its greatest density. The fish, therefore, lives in a world where the temperature range between winter and summer is very small (32° to 65° F.) compared to conditions on land, where extremes such as "40° below zero" and "110° in the shade" may be experienced.

Since fish are cold-blooded, their activities, including rates of growth, vary with the temperature. In late spring and early summer the fish eat a great deal, grow rapidly, and are very active, while in the winter they tend to be sluggish, feed little, and practically cease growing.

STRUCTURE.

Before attempting to identify a fish accurately, it is necessary to know something concerning its structure, since most descriptions include references to particular parts or features.

Body Shape.—A typical fish is more or less "cigar-shaped" or "torpedo-shaped," being cylindrical in cross-section, with rounded nose, greatest thickness in the front half, and tapering to the tail. This is the shape commonly referred to as "stream-lined." Some of our fishes, such as the trouts, suckers, and Rocky Mountain whitefish, are of this general shape; some, like the bass and sunfish, are com-

pressed (flattened side to side); some, like the catfishes and sculpins, are depressed in the head region (flattened from above downward). The shape of the body is closely related to the swimming habits of the fish. Those with rounded bodies are active, long-range swimmers; those with compressed bodies are quick-turning fish; those with depressed bodies are bottom-living fish.

The body of a fish is divisible into three main parts—head, trunk, and tail. The head includes the portion from the snout to the posterior edge of the gill cover; the trunk from this point to the anal opening; and the tail from the anus to the fork of the tail fin.

Body Covering.—Embedded in the skin of most fishes are series of thin bony or fibrous plates known as scales, usually arranged in overlapping rows, after the style of shingles on a roof. When a fish is first hatched, scales are absent, but they soon begin to develop in minute pockets beneath the outermost layer of skin. As the fish increases in size, the scales also increase proportionately, so that the number and arrangement remain approximately the same throughout the life of the fish. Each scale grows by adding layers of fresh material to the outer margin in concentric rings or "circuli." In summer, when temperatures are high and food is plentiful, growth is rapid, resulting in widely spaced rings. In winter, when the rate of growth is much slower, the rings added to each scale are fewer in number and more closely crowded. The beginning of the new growth of the year is usually marked by a continuous circulus. Change of direction of circuli and discontinuity in circulus formation are the criteria usually used in determining the growth regions. Thus the scales of a fish are of great value to an experienced investigator because the age of the fish and other details of the life-history can be obtained by examining the scales under a microscope.

The number of scales in a row, the number of rows and their relative positions combine to form a scale pattern which is characteristic for each species and is therefore often used in identification of fishes.

Scales are of three main types: "ganoid," which are plate-like, such as found on the sturgeon; "cycloid," which are thin and smooth-edged, such as on salmon and trout; and "ctenoid," which are finely toothed, as on bass and perch. Some fishes, such as the cat-

fishes and some sculpins, lack scales but have evolved from scaled ancestors. Both scaled and scaleless fishes, however, have a thin coating of mucus or slime produced by glands in the skin. The slime serves to reduce friction between the fish and the water and at the same time forms a protection against attack by disease organisms, fungi, and other parasites.

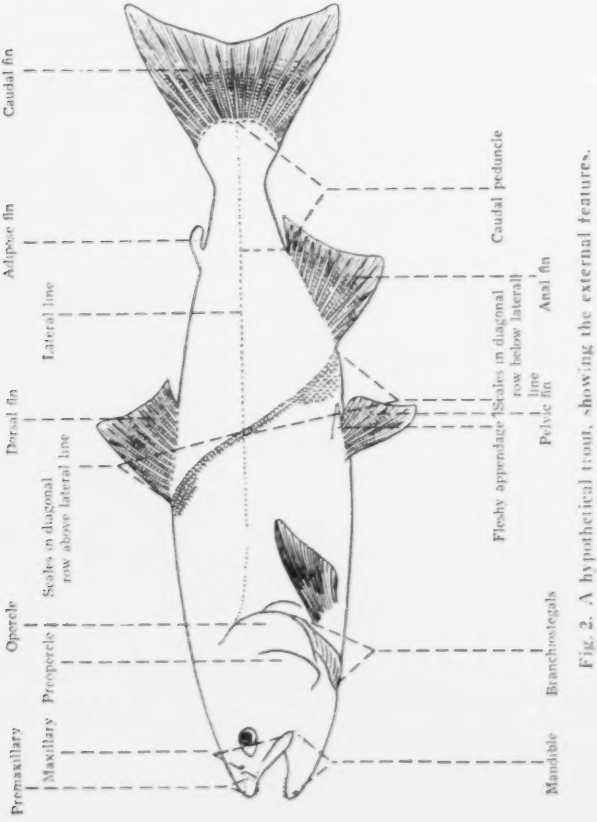


Fig. 2. A hypothetical trout, showing the external features.

Locomotion.—Contrary to popular belief, the body of a fish, and not the fins, is the main swimming organ, since it is the muscles of the trunk and tail which do the work of driving the fish through the water. The fins are accessory organs of locomotion; they add to the efficiency of the sculling motion of the tail and aid in balancing and turning. Some fishes, such as the sticklebacks, provide exceptions to the rule, for in these species swimming is accomplished mainly by the pectoral fins and not by the body, which is held stiffly when travelling through the water.

Structurally, fins are outgrowths of skin supported by soft or spiny rays. Some of the rays may be specially strengthened to form protective spines, as in the stickleback and catfish. One fin, the adipose, lacks rays of any kind. Typically, there are two sets of paired fins and three unpaired or single fins. These are named and arranged as shown in Fig. 2. Fins vary greatly in size, shape, and position among the various species of fishes and, as a consequence, are much used in the classification of fishes.

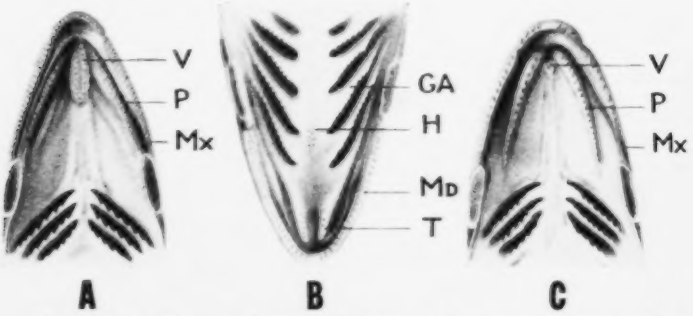


Fig. 3. Jaws and teeth of trout and char. (*A*) Upper jaw and roof of mouth of cut-throat trout (*Salmo*). (*B*) Lower jaw, tongue, and lower half of gill arches of cut-throat trout. (*C*) Upper jaw and roof of mouth of Dolly Varden (*Salvelinus*). *V* = vomer with teeth; *P* = palatine bone with teeth; *Mx* = maxillary; *Md* = mandible; *GA* = gill arch; *H* = hyoid teeth on base of tongue; T = teeth on tip of tongue.

Feeding and Digestion.—The mouth and the structures associated with it form the chief food-collecting apparatus. The mouth varies much in size, position, and dentition according to the feeding habits of the species. In size it may vary from the tube-like mouth of the stickleback to the wide gape of the sculpin; in position it may be terminal, as in salmon and trout, or inferior, as in the sturgeons, or subterminal, as in the suckers. In armature it may be equipped with many teeth, as in the pike, or with none at all, as in the sturgeon.

The teeth may be present on both upper and lower jaws, on the roof of the mouth (on both vomer and palatine bones), and on the tongue (*see* Fig. 3). These teeth are not used to chew food, as in higher animals, but to hold the prey in preparation for swallowing. In addition to teeth in the mouth, some fishes, such as minnows and suckers, have teeth in the throat ("pharyngeal teeth") which are apparently used in breaking up their food (*see* Fig. 4). Other fishes,

Fig. 4. Pharyngeal teeth in the minnows. Left: chub (*Mylocheilus*). Right: squawfish (*Ptychocheilus*).

such as kokanee and ciscoes, are provided with extra long "gill rakers" (comb-like processes on the gill arches) (*see* Fig. 5) which act as strainers for collecting the minute animals and plants known collectively as "plankton," which forms their principal food.

The internal organs of digestion consist of a stomach, intestine, and associated structures. Connected to the upper end of the intestine is a series of finger-like structures called "pyloric cæca" (singular, "cæcum") whose function is evidently the production of a digestive

ferment. The number of cæca varies slightly among individuals of a given species but differs considerably from species to species, and consequently is often used in the identification of fishes, particularly salmon.

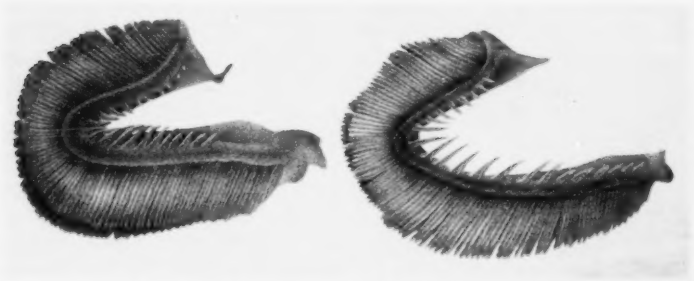


Fig. 5. Gill arch, showing gill filaments and gill rakers. Left: Rocky Mountain whitefish (*Prosopium*). Right: common whitefish (*Coregonus*).

Respiration.—The organs of respiration are the gills, which are located on each side of the head and are covered by the "opercles" or "gill covers." Each gill consists of a bony "arch" supporting a number of "gill filaments" which are richly provided with blood-vessels. Also associated with the arch are the "gill rakers," which in some fish are elongated to form a food-collecting mechanism. The number of rakers on each arm of the arch is often used in the determination of species.

A fish "breathes" by opening its mouth and drawing in a quantity of water. The mouth is then closed and the water is forced past the gills to the outside by way of the opening beneath the operculum. While flowing over the gill filaments, the water gives up part of its dissolved oxygen and carries away dissolved carbon dioxide. A fish suffers from asphyxia and may die if insufficient oxygen is present in the water or if too great a quantity of carbon dioxide is in solution. It also dies of suffocation out of water because respiratory movements cannot be carried on without the support of the water or because the gill filaments dry out and are no longer able to carry on the exchange

of gases. Some coarse fishes, such as catfishes and carp, are able to survive quite long periods out of water, apparently because they are able to use the oxygen of the air as long as the gills remain moist. Catfishes and carp are also able to swallow air and to abstract some oxygen through the air-bladder, an accomplishment which permits them to survive in water deficient in dissolved oxygen.

Reproduction.—The organs of reproduction in fishes consist of "ovaries" in the female and "testes" in the male, elongated structures lying close to the kidneys and connected to the outside by a pair of tubes opening near the anus. The ovaries produce eggs, each of which, when penetrated by a sperm produced by the testes, is capable of developing into a new individual. In some fishes both fertilization and development is internal, the female giving birth to living young. In some, fertilization only is internal, development taking place after the eggs are laid. In most fishes, including all found in the fresh waters of this Province, fertilization is external, both eggs and sperms being discharged almost simultaneously.

The number of eggs produced by a female varies considerably from species to species, associated with the extent of parental care. Sticklebacks, catfishes, and bass, the males of which stand guard over the nest, deposit only a few hundred eggs. Salmon, trout, carp, and others, in which no parental care is given to the eggs or young, lay several thousand eggs per female. In any species the number of eggs produced seems to be in direct proportion to the mortality experienced by eggs and young stages because, on the average, from the total number of eggs laid by a fish during its lifetime only one pair of fish results.

Sense Organs.—Fishes are commonly looked upon by the layman as creatures in which the senses are poorly developed, but this is not found to be true when they are investigated carefully. As a matter of fact, besides the usual organs of sense, such as eye, ear, mouth, nostril, and skin, fishes have an additional organ known as the "lateral line," so that from the standpoint of numbers of sense organs fishes are better equipped than land animals.

The eye of a fish does not differ fundamentally from that of a human being, but there are several small differences in structure, position, and function which adapt it to the conditions existing beneath

the surface of the water. A fish apparently sees near-by objects quite clearly; more distant objects are probably out of focus, but this is no great handicap in a submarine world where light conditions restrict vision to a small area. Experiments have also proved that some fishes can distinguish certain colours, and that all fishes therefore are not completely colour-blind, as some persons believe. To some extent this vindicates the fisherman who relies on using artificial flies of a certain colour, although it must be pointed out that a dry fly viewed against a bright sky must appear to the fish as a black silhouette, regardless of its colour. It is only when the fly or other lure is beneath the surface of the water that the colours become distinguishable to the fish.

Fishes, such as the trouts and sunfish, which are capable of changing their colour intensity or pattern according to their habitat receive through the eye the stimuli that effect the change. Fishes which have become blinded through accident or disease fail to adjust their pigmentation to the conditions in their surroundings and are therefore easily distinguished from their companions.

Although fishes have no external indication of ears, they have internal structures, one on each side of the head, very similar to those of land animals. These structures function as organs of equilibrium and also as "ears," permitting the fish to hear underwater sounds. The range of audible sound, however, is somewhat restricted as compared to that of a human being.

In most fishes the upper portion of the body cavity is occupied by a large thin-walled sac, the "air-bladder" or "swim-bladder," which in some species is connected to the pharynx by a "pneumatic duct." The bladder is filled with a mixture of gases, usually oxygen, nitrogen, and carbon dioxide, and serves as a hydrostatic organ to adjust the specific gravity of the fish to that of the water at different depths. In the suckers, catfish, carp, and other minnows a series of four small bones, the "Weberian ossicles," connects the air-bladder with the inner ear to form an additional aid to hearing. Fishes equipped with this apparatus have been shown to hear much more keenly than those which lack this connection with the swim-bladder.

Along each side of the body in most fishes is the lateral line, already mentioned, which usually extends from the head to the tail in

a series of pore-like openings. These are in communication with the brain through a nerve system which transmits low-frequency vibrations, enabling the fish to " hear " such things as an approaching fish or to detect obstacles in its path. The lateral line also performs the function of a heat receptor, serving to warn the fish of rapid changes in water temperature.

The sense of taste is apparently not highly developed in fishes such as the trouts, which depend upon the eye for locating food and which bolt their food without chewing, but in suckers and other bottom feeders the taste sense may be quite well developed, permitting a sorting and selecting of food materials. In these, " taste buds " are concentrated around the fleshy lips and may occur over much of the surface in the fore parts. The senses of taste and smell are probably intimately connected in fishes as in higher animals so that it is not always possible to distinguish between them. Thus the long barbels around the mouth of a catfish may be regarded as organs of both taste and smell. These structures enable the catfish to locate food which may be some distance away or obscured by muddy water apparently by detecting minute particles given off in solution or suspension. The sense of taste and smell seems to be most highly developed in those fishes which have the poorest eyesight.

The nostrils also function as sensory organs, presumably being used in locating food. Unlike those of other animals, the nostrils of the higher fishes do not communicate with the mouth cavity, but end in shallow pits lined with the organs of smell. In some species the nostril opening is divided into two; a tiny stream of water is carried in one and out the other by the beating of paddle-like " cilia " lining the nostril cavity.

A fish is well equipped indeed for its life under water.

DISTRIBUTION OF FISHES IN BRITISH COLUMBIA.

About 30,000 years ago the area now known as British Columbia was covered with the ice of the last glacial period and no fish could have been present. As the ice gradually melted, water filled the depressions in the land surface and water areas became populated with plants and invertebrate animals; various species of fishes were

able to move in from areas outside the region once covered by the ice. The fishes followed various watercourses and occupied the lakes and streams as far as food and environmental conditions permitted.

There appear to have been four routes by which fishes entered British Columbia. These and some of the fishes using them are as follows:—

(1) From the south through the Columbia and Fraser river systems: Rocky Mountain whitefish, Yellowstone cut-throat, Kamloops trout, fine-scaled sucker, coarse-scaled sucker, squawfish, peamouth, redside shiner, ling.

(2) From the mid-section of the continent through the Great Lakes, the Manitoba lakes into the Mackenzie river system, and into British Columbia by the Bear and Liard rivers: Common whitefish, fine-scaled sucker, white sucker, northern minnow, long-nose dace, redbelly dace, brook stickleback, ling, pike-perch.

(3) From the lower Yukon river basin, which was unglaciated, into Bennett, Tagish, Atlin, and Teslin lakes: Common whitefish, round whitefish, cisco, inconnu, Arctic grayling, Great Lakes char, fine-scaled sucker, pike, ling, mottled sculpin.

(4) From the sea: Lampreys, sturgeons, salmons, coastal cut-throat, steelhead, Dolly Varden char, three-spined stickleback, several sculpins.

It may be noted that some species have invaded the Province by more than one route. The cut-throat of south-eastern British Columbia had its origin in the Montana area, while the coastal cut-throat entered from the sea. The ling came in from the south, east, and north.

Furthermore, some fishes have entered the Province in very recent times, as, for example, from the south the carp, tench, and largemouth bass, and from the sea the shad.

In addition, a considerable number of species have been introduced by man accidentally or by fish-cultural operations, as, for example, the common whitefish, brown trout, Eastern speckled char, the catfishes, smallmouth bass, largemouth bass, yellow perch, sunfish, and crappie.

Because of the geological formation and the geological history of British Columbia, the fish fauna is varied, but limited, in the number of species. The number of native forms, including subspecies, is only 49, which with 14 recent migrant and introduced species makes a total of 63. In contrast, there occur in the Province of Ontario approximately 200 forms.

ECONOMIC IMPORTANCE.

The fresh waters of British Columbia support immense numbers of very valuable fishes. Each year millions of salmon and many sturgeon, steelhead, eulachon, and shad enter the streams and lakes to spawn. The progeny of these fishes remain for a few weeks to three years and then migrate to the sea, where they complete their growth and eventually support a commercial fishery. The value of these fishes caught in 1944 exceeded $15,000,000.

At the present time commercial fishing is carried on in fresh water only in the mouths of the Fraser, Skeena, and Nass rivers and is based upon the above-mentioned fishes. The lakes and streams do not produce sufficient numbers of whitefish, pike-perch, or other species to support inland commercial fisheries. However, Indians are permitted to take certain fishes such as salmon and eulachon from various streams for their own uses, and a few licences are issued annually for the taking of kokanee for local food purposes and for the taking of coarse fishes such as suckers, squawfish, and carp for food for animals in fur farms. Such licences are issued by the Provincial Fisheries Department, Victoria.

The lakes and streams, in addition to acting as nurseries for certain commercial fishes, constitute a vast array of waters for sport fishing. In the coastal streams, from tidal waters upward, there are taken coho salmon, steelhead, cut-throat, and brown trout, and Dolly Varden char. In the inland lakes and streams a variety of fishing is provided by Kamloops and cut-throat trout and their mountain varieties, Great Lakes char, Arctic grayling, Rocky Mountain whitefish, kokanee, basses, yellow perch, speckled and Dolly Varden chars, and pike.

The monetary value of the sport fishes of the Province cannot be accurately calculated. Angling licences are issued by the Pro-

vincial Game Commission, Vancouver. The number and the revenue derived therefrom in 1946 was as follows:—

Resident anglers' licences, 42,527 @ $1	$42,527.00
Non-resident anglers' licences, 12,071 @ $3.50 to $7	72,464.00
Total	$114,991.00

On the basis of a non-resident angler remaining in the Province for one week and spending $10 per day, the total amount of money left in the Province in 1946 would be approximately $840,000.

IDENTIFICATION OF SPECIMENS.

To help in the identification of a fish, a system of "keys" is presented. Each key is made up of a series of "true and false" statements. To use a key, the first statement is examined; if this is correct for the fish in question, proceed to the next statement and continue to pass to successive statements until a name is reached at the end of a line. If, however, the statement does not apply, pass to the alternative statement indicated by the number in parentheses. Continue in this way until an identification is obtained.

The key which follows provides a means of determining the family to which the fish belongs. To identify as to species, it is necessary to refer to the key given under the family account. In each case the determination should be verified by referring to the illustration and to the description given for each species.

If the fish cannot be identified satisfactorily by using the material in this booklet or if further confirmation of the identification is required, preserve the specimen as directed in the appendix and send it to the Provincial Museum, Victoria, B.C., or to the Department of Zoology, University of British Columbia, Vancouver, B.C.

KEY TO THE FAMILIES OF FRESH-WATER FISHES OF BRITISH COLUMBIA.

1 (2) Mouth in a circular sucking disk; jaws absent.
The Lampreys. Family Petromyzonidæ.

2 (1) Mouth not in a circular sucking disk; jaws present.

3 (4) Bony shields on body in 5 widely separated rows; mouth ventral; upper lobe of caudal fin much longer than lower—i.e., heterocercal.

The Sturgeons. Family Acipenseridæ.

4 (3) No bony shields on body; mouth terminal or subterminal; caudal fin not heterocercal.

5 (22) Pelvic fins placed far back on body, never under pectoral fins—i.e., abdominal in position.

6 (7) Large specialized scales on each side of base of caudal fin, 2; scales on belly forming a series of sharp, keeled scutes; row of round black spots on each side of body.

The Herrings. Family Clupeidæ.

7 (6) No specialized scales on either side of base of caudal fin; no keeled scutes; no row of round black spots on each side of body.

8 (15) Adipose fin present, together with scales on body.

9 (10) No fleshy appendage at base of each pelvic fin.

The Smelts. Family Osmeridæ.

10 (9) Fleshy appendage at base of each pelvic fin.

11 (14) Scales large, fewer than 100 in lateral series.

12 (13) Dorsal fin with fewer than 20 rays, its base shorter than head.

The Whitefishes. Family Coregonidæ.

13 (12) Dorsal fin with 20 or more rays, its base longer than head.

The Grayling. Family Thymallidæ.

14 (11) Scales small, more than 100 in lateral series.

The Salmon, Trout, and Char. Family Salmonidæ.

15 (8) Adipose fin absent, or if present, scales absent from body.

16 (21) Gill membranes broadly joined below the isthmus or broadly joined to it; snout not long.

17 (20) Scales present; no adipose fin; no barbels about mouth.

18 (19) Mouth subterminal, lips thick, plicate or papillose, fitted for sucking; pharyngeal teeth numerous, comb-like.

The Suckers. Family Catostomidæ.

19 (18) Mouth not as above; pharyngeal teeth fewer than 9 on each side.
The Minnows. Family Cyprinidæ.

20 (17) Body without scales; adipose fin present; barbels about mouth.
The Catfishes. Family Ameiuridæ.

21 (16) Gill membranes completely separate from the isthmus except at anterior tip; snout long.
The Pikes. Family Esocidæ.

22 (5) Pelvic fins placed far forward on body beneath or in front of pectoral fins—i.e., thoracic in position.

23 (24) Anterior dorsal fin represented by free spines which precede a rayed dorsal fin.
The Sticklebacks. Family Gasterosteidæ.

24 (23) Anterior dorsal fin not represented by free spines.

25 (26) Dorsal fins, two, both rayed, second long with 65 to 75 rays; barbel beneath chin.
The Codfishes. Family Gadidæ.

26 (25) Dorsal fins not as above; no barbel beneath chin.

27 (30) Body covered with distinct ctenoid scales.

28 (29) Anal spines, 1 or 2; dorsal fins entirely separate.
The Perches. Family Percidæ.

29 (28) Anal spines, 3 to 10; dorsal fins joined.
The Basses and Sunfishes. Family Centrarchidæ.

30 (27) Body without scales or with minute prickles.
The Sculpins. Family Cottidæ.

THE LAMPREYS. Family PETROMYZONIDÆ.

Because the members of this family are not true fishes, they are grouped in a distinct class known as the Cyclostomata (circular mouth) or the Marsipobranchii (pouch-gills). Lampreys lack jaws, ribs, paired fins, and scales; the mouth is circular in outline and designed for sucking. Both mouth and tongue are provided with horny teeth which are well developed in predaceous species. The gills lie in pouch-like sacs which open to the outside by seven holes on each side of the head region.

KEY TO THE SPECIES.

1 (2) A posterior series of small teeth parallel to the marginal series and connecting the last pair of laterals.
Pacific lamprey—*Entosphenus tridentatus.*

2 (1) No small teeth on posterior portion of disk connecting laterals.

3 (4) Dorsal fins barely separated; myotomes between last gill opening and anus, 57 to 66; teeth weak and blunt.
Brook lamprey—*Lampetra planeri.*

4 (3) Dorsal fins well separated; myotomes between last gill opening and anus, 68 to 74; teeth sharp and strong.
Western lamprey—*Lampetra fluviatilis.*

PACIFIC LAMPREY.
Sea Lamprey.

Entosphenus tridentatus (Gairdner).
Entosphenus = within wedge, the lingual tooth being wedge-shaped.
tridentatus = three-toothed.

Description.—Body long and eel-like. Length up to 27 inches. No true jaws. Mouth circular, in the form of a sucking disk. Teeth strongly developed; in three groups. No pectoral or ventral fins; dorsal fins well separated. Seven gill openings on each side of body behind head; single nostril on top of head. No scales. Myotomes between last gill opening and the vent, 68 to 74.

Colour dark brown to almost bluish-black; lighter below. Mouth and lips sometimes yellowish-orange.

Distribution.—Pacific coast from Unalaska to southern California. In British Columbia it is probably present in all coastal streams. It is known to occur in the following bodies of water: Cowichan river system, Stamp river at Stamp falls, Millstream (Nanaimo), Colquitz river (Victoria), Fraser river at Hell's gate, Chilliwack river, Chilcotin river at Farewell canyon, Birkenhead river, headwaters of the Columbia, and tributaries of the Skeena river.

Notes.—In the adult stage the Pacific lamprey is predaceous upon fishes. The greater part of its life is spent in the sea, where it preys upon many species of fish, deriving nourishment by feeding upon blood and tissues obtained while attached to its victim. To prevent clotting of the blood during the feeding process, an anti-coagulant is injected into the victim. Fish are greatly weakened by such attacks, but apparently many survive, as indicated by the numbers of individuals bearing scars of former lamprey attacks.

Pacific lampreys ascend both rivers and streams to spawn, often travelling long distances and surmounting many obstacles, such as waterfalls and dams. They may be seen in large numbers ascending the fish-ways at Stamp falls in the Alberni district, usually in June. Adults are commonly seen in May in Millstream at Nanaimo, where they congregate below the power-house, and individuals have been noted during June at Skutz falls, Cowichan river. Very large individuals appear at Moricetown falls on the Bulkley river, tributary to the Skeena river, in June of each year. They spawn in sandy gravel at the head of riffles, much after the fashion of the brook lamprey, as described on the following pages; after spawning they die.

The young pass through a larval stage buried in the bottom silt, feeding upon microscopic life. During this time they have an oral hood instead of an adhesive disk about the mouth; they lack teeth and the eyes are undeveloped. At the end of several years they change to the adult form, emerge from the stream-bottom and migrate to sea, where they take up the predaceous habit. In Cowichan lake and river lampreys appear to pass through a fresh-water predaceous stage, during which time they prey upon the trout population to a large extent.

The lampreys of some British Columbia streams, such as the Cowichan river, represent a somewhat dwarfed race.

BROOK LAMPREY. *Lampetra planeri* Bloch.
Lampetra = a sucker of stone.
planeri = after J. J. Planer, a German botanist.

Description.—Body long and eel-like. Length up to 6 inches. No true jaws. Mouth circular, in the form of a sucking disk. Teeth weak and blunt. No pectoral or ventral fins; dorsal fins separated only by a notch to base. Seven gill openings on each side of body behind head; single nostril on top of head. No scales. Myotomes between the last gill openings and the vent, 57 to 66.

Colour olivaceous-green, darkening to greyish-black on sides; dark grey on ventral surface. Fins, translucent olive-green.

Distribution.—Streams of Europe and western North America.

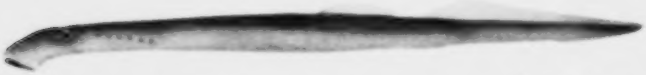
In British Columbia brook lampreys are known to be present in the Cowichan river system on Vancouver island and in the streams of Cultus lake on the lower mainland. They are probably present in most coastal streams.

Habits.—The brook lamprey is nonpredaceous. In fact, in the adult stage, it does not feed at all, living only long enough to reproduce the species. Spawning takes place in the spring, the time apparently depending upon the temperature of the water. In Holmes creek, a tributary of Somenos lake, near Duncan, spawning was observed during the first week of May, 1939, when the water was about 53° F. In Smith Falls creek, flowing into Cultus lake, lampreys were seen spawning on May 30th, 1942, but they were said to be present all through April.

Nests are usually constructed among small stones mixed with sand at the head of a riffle and in comparatively quiet water. Little excavation occurs, the average nest seldom being more than 2 inches in depth and 4 or 5 in diameter. Construction is accomplished

partly by wedging stones apart with the body and washing fine gravel and sand down-stream by the current assisted by body vibrations. Small stones may be dragged short distances in the suctorial mouth.

During the spawning act the female is usually headed up-stream attached to a stone. The male fastens himself to the female by applying his sucking mouth close behind her head. He twines his body around hers and a number of eggs are laid during rapid vibrations of both partners. The eggs are about one twenty-fifth of an inch in diameter and dead white in colour. The incubation period in British Columbia does not appear to be known. The larvæ burrow in silt accumulated in back eddies and feed upon microscopic material filtered from the water. After at least four years they transform to the adult stage, spawn and die.



— Frank L. Beebe —

WESTERN LAMPREY. *Lampetra fluviatilis* Linnaeus.
fluviatilis = of streams.

Description.—Body long and eel-like. Length up to 8 inches. No true jaws. Mouth circular, in the form of a sucking disk. Teeth sharp and strong. No pectoral or ventral fins; dorsal fins well separated by an interspace. Seven gill openings. Myotomes between the last gill openings and the vent, 68 to 74.

Colour greyish-black, silvery on sides.

Distribution.—Coasts and streams of northern Europe and western North America.

In British Columbia this lamprey has been reported from Cultus lake, Fraser river, and Cowichan river.

Habits.—The western lamprey, like its near relative the Pacific lamprey, is predaceous on fishes. Practically nothing is known of its life-history in British Columbia, but it is probably similar to the Pacific lamprey in this respect. Since there are records of this

lamprey from Puget sound, San Pablo bay, and San Francisco bay, the life-history of the species is probably much the same as in Europe, where it is known to go to sea and to return to streams to spawn.

THE STURGEONS. FAMILY ACIPENSERIDÆ.

A sturgeon is easily distinguished by its elongated snout, ventrally placed sucking mouth, and shield-like plates or scutes on back and sides. Four barbels are located in a row anterior to the mouth. The upper lobe of the tail fin is elongated (heterocercal). Internally, the skeleton is of cartilage.

The sturgeons are modern representatives of an ancient group of fishes and are widely distributed in the Northern Hemisphere.

KEY TO THE SPECIES.

1 (2) Lateral shields, 38 to 48; barbels nearer tip of snout than mouth; colour grey.
White sturgeon—*Acipenser transmontanus.*

2 (1) Lateral shields, 23 to 30; barbels nearer mouth than tip of snout; colour, green.
Green sturgeon—*Acipenser medirostris.*

WHITE STURGEON. *Acipenser transmontanus* Richardson.
Acipenser = sturgeon.
transmontanus = beyond the mountains.

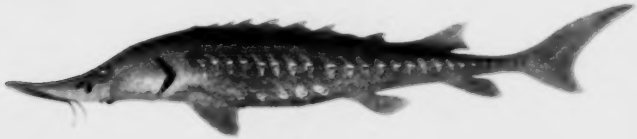
Description.—Body elongate, subcylindrical. Length up to 20 feet and weight in excess of 1,000 pounds. Head flattened, snout sharp in young, becoming short and blunt in the adult. Mouth small, directed downward with thick lips but no teeth. Four barbels in front of mouth. Anal fin below dorsal; its base about half as long. Upper lobe of tail fin elongated. Head and back covered

with bony plates; body with 5 rows of shields, each with a median ridge ending in a spine. Dorsal shields, 11 to 14; lateral shields, 38 to 48; ventrolateral shields, 9 to 12.

Colour dark grey, and with no stripes.

Distribution.—Pacific coast from Monterey, California, to Alaska. In British Columbia it is known to be present in the following bodies of fresh water: Fraser river (and tributaries such as Harrison river, Stuart lake, Takla lake, Stellako river), Kootenay lake and river, Columbia river above Revelstoke, and possibly in Okanagan lake.

NOTES.—The white sturgeon is the largest fish found in the fresh waters of this Province. Individuals weighing up to 1,800 pounds have occasionally been taken in the Fraser river. Like Pacific salmon, sturgeon spend part of their lives in the sea and ascend the larger rivers in the spring to spawn. In fresh water this fish is a bottom feeder, taking crustaceans and molluscs, and is said to feed upon eulachons in the Fraser river. The roe of an 800-pound female weighs about 50 pounds and commands a high price as caviar.



GREEN STURGEON. *Acipenser medirostris* Ayres.
medirostris = moderate snout.

Description.—Body elongate, subcylindrical. Length up to 7 feet and weight up to 350 pounds. Head much the same as in the white sturgeon. Anal fin nearly as long as dorsal and mostly behind it. Upper lobe of tail fin elongated. Head covered with bony plates; body with 5 rows of shields, each with a median ridge ending in a spine. Dorsal shields, 8 to 11; lateral shields, 23 to 30; ventrolateral shields, 5 to 10.

Colour olive-green, with an olive stripe on the median line of the belly and one on each side above the ventrolateral shields.

Distribution.—Pacific coast, from San Francisco northward.

In British Columbia it is known authentically only by one specimen taken at Victoria in August, 1908. It is said to be captured occasionally in the Fraser river area in salmon gill-nets and to occur off the west coast of Vancouver island.

NOTES.—The green sturgeon is apparently rarely found in fresh water, preferring to spend much of its time about the mouths of rivers. It is not so highly prized as a food fish as is the white sturgeon.

THE HERRINGS. FAMILY CLUPEIDÆ.

The members of this group are small- to medium-sized fishes characterized by a single spineless dorsal fin and a forked tail. Most species, such as the herring and pilchard, are marine; one, the shad, introduced on this coast, enters fresh water to spawn.

SHAD. *Alosa sapidissima* (Wilson).
Alosa = an old Saxon name for European shad.
sapidissima = most delicious.

Description.—Body deep and compressed from side to side. Length up to 30 inches. No teeth on jaws. Upper jaw with deep notch at tip. Striations on gill cover coarse and fan-like. Scales in lateral series, about 60; those on belly strongly keeled.

Colour bluish on back, silvery-white on sides and belly. Round black spots on side of body in a row; most conspicuous when scales are removed.

Distribution.—Atlantic coast of North America (native); Pacific coast from San Diego northward to Alaska (introduced).

In British Columbia shad have been taken from several areas along the coast in salt water but in fresh water the only records are from the Fraser river.

Notes.—The first planting of shad on the Pacific coast was in 1871 in the Sacramento river, California, and this introduction was followed by others as far north as the Columbia river, where a fishery of considerable importance has developed. The species was first reported as occurring in British Columbia waters in 1891 following the capture of a full-grown specimen in the Fraser river in July of that year. The following year several shad were taken in the North arm of the Fraser and others were taken at Rivers inlet, about 250 miles north of the Fraser. Since that time shad have been taken occasionally in these and other localities in British Columbia, and lately the number taken near the mouth of the Fraser has increased, which indicates that in time this fish may become of commercial importance in this Province.

Shad enter fresh water to spawn, preferring shallow flats near the mouths of creeks as a spawning-ground. The young enter salt water in the fall and probably mature at the age of 3 or 4 years.

THE SMELTS. FAMILY OSMERIDÆ.

The smelt family is composed of small fishes, most of which live in the sea; some species enter fresh water to spawn. They resemble salmonids in body shape and in the presence of an adipose fin, but differ in having fewer than 100 scales along the lateral line.

KEY TO THE SPECIES.

1 (2) Pectoral fins distinctly shorter than length of head; striæ on opercular bones following contour, well defined.
Eulachon—*Thaleichthys pacificus.*

2 (1) Pectoral fins as long as length of head or longer; no striæ on opercular bones.
Long-finned smelt—*Spirinchus dilatus.*

EULACHON.
Candlefish.

Thaleichthys pacificus (Richardson).
Thaleichthys = rich fish (referring to the high oil content).
pacificus = of the Pacific.

Description.—Body elongate and compressed. Head long. Conspicuous concentric striations on gill cover. Total length 12 inches. Dorsal fin with 11 to 13 rays; inserted behind ventrals. Adipose fin present. Pectoral fins shorter than head. Males possess distinctly longer paired fins than females and have small tubercles on sides, back, and head at spawning time.

Colour whitish, dark iron-grey above.

Distribution.—Klamath river, northern California, north to Bering sea.

In British Columbia eulachons ascend most of the larger rivers of the mainland coast.

Notes.—Eulachons enter rivers in large numbers each spring for the purpose of spawning. In the Fraser the spawning run usually takes place in April and May; most of the fish are completing their second year of life at this time, while a few are in their third year; all apparently die soon after spawning. The major spawning-grounds appear to be along the stretch of river between Mission and Chilliwack. When laid, the eggs are provided with a double outer membrane. The outer layer is easily broken; it separates from the inner covering, becomes turned inside out but still attached by a short stalk. The edges of the broken membrane are extremely

adhesive and become attached to particles of sand which anchor the egg to the bottom. The young hatchlings drift down-stream with the current and soon enter the salt water.

Eulachons are extremely oily; when dried and provided with a wick they burn readily, hence the name candlefish. The Indians of this coast, particularly the Tsimshians of the Nass and Skeena rivers, catch large numbers of eulachons each spring. Some are dried for winter use, but the majority are rendered and the oil extracted for use as food. In the old days eulachon "grease" commanded a high price and was widely distributed by trade even into the interior of the Province.

LONG-FINNED SMELT.

Spirinchus dilatus Schultz and Chapman.
Spirinchus = old name used by Jonston for the smelt.
dilatus = refers to enlarged scales along the lateral line in spawning males.

Description.—Body elongate and compressed. Head long and pointed. No striations on gill cover. Total length 6 inches. Dorsal fin with 6 to 10 rays; inserted behind ventral fins. Adipose fin present. Pectoral fins as long as head or longer.

Colour silvery, with prominent black stippling on back and head.

Distribution.—Tillamook head, Oregon; Puget sound; Burrard inlet to northern British Columbia.

In the fresh waters of British Columbia it is known only from Harrison lake and from the Fraser river below New Westminster.

where small specimens between 2 and 3 inches in length have been taken in May.

Notes.—The long-finned smelt spawns from October to December in streams near the sea. The food consists of small crustaceans. The fish has a good flavour, and small quantities are marketed.

THE WHITEFISHES. FAMILY COREGONIDÆ.

The Coregonids are distinguished by their silvery appearance, weak jaws with few or no teeth, and soft-rayed fins. An adipose fin is present in all members of the family.

They are widely spread in the northern river systems of the Northern Hemisphere and are of considerable economic importance as food fishes.

KEY TO THE SPECIES.

1 (6) A single flap between nostrils; body subterete.
2 (5) Scales in more than 70 rows.
3 (4) Scales in 74 to 90 rows; gill rakers 20 to 26.
Rocky Mountain whitefish—*Prosopium williamsoni.*
4 (3) Scales in 86 to 100 rows; gill rakers 16 to 20.
Round whitefish—*Prosopium cylindraceum quadrilaterale.*
5 (2) Scales in 59 to 64 rows.
Coulter's whitefish—*Prosopium coulterii.*
6 (1) Two flaps between nostrils; body compressed.
7 (8) Premaxillaries vertical or turned backward (retrorse).
Common whitefish—*Coregonus clupeaformis.*
8 (7) Premaxillaries turned forward (antrorse).
9 (10) Gill rakers 37 to 52; scales in 71 to 97 rows.
Cisco—*Leucichthys sardinella.*
10 (9) Gill rakers 19 to 23; scales in 97 to 107 rows.
Inconnu—*Stenodus leucichthys mackenzii.*

ROCKY MOUNTAIN WHITEFISH.
Williamson's Whitefish.

Prosopium williamsoni (Girard).
Prosopium = a mask, from the large bones in front of the eyes.
williamsoni = after Lieut. R. S. Williamson of the U.S. Pacific Railroad exploration.

Description.—Body trout-like. Length up to 18 inches and weight up to 3 pounds. Mouth small, with no teeth. Nostril with a single flap between openings. Gill rakers 20 to 26. Scales in 74 to 90 rows. Rays in anal fin, 10 to 12.

General colour silvery, with dark-bronze back. Parr marks are present in the young stages.

Distribution.—Lakes and streams of the west slope of the Rockies from the Skeena and Fraser systems to Truckee river and Lahontan basin of Nevada.

In British Columbia Rocky Mountain whitefish are known to be present in the following: Kitwanga, Babine, Bear, Morrison, Swan, and other lakes (Skeena system); Takla lake, Cluculz lake, Lac la Hache, Shuswap lake, Adams river, Eagle river, Salmon river, Mabel lake, Sugar lake, Harrison lake, Cultus lake, Chilliwack river (Fraser system); Similkameen river, Okanagan lake, Woods lake, Kalamalka lake, Dog lake (Okanagan-Columbia system); Columbia river at Golden and Revelstoke, Arrow lakes, Christina lake, Slocan lake, Kootenay lake and river, Lake Windermere, Columbia lake, Watshan lake, Moyie lake, St. Mary lake, Goat and Elk rivers (Columbia system).

Notes.—The Rocky Mountain whitefish is chiefly a bottom-feeding species, the most important food being aquatic insect larvæ. The diet varies considerably with locality, and in waters which are poor in bottom food, feeding may take place at any level, including the surface. Since it will often take an artificial fly, it is of some value as a sport fish, particularly in swift-flowing mountain streams, where it may put up a gamey fight. It also has some value as a food fish, but since it competes for food with trout and salmon and at times takes the eggs and young of these species, its presence in a lake may not always be desirable. (McHugh, 1940*a*).

In some parts of the Province the Rocky Mountain whitefish is incorrectly called "grayling." It is commonly taken in gill-nets in Bear and Takla lakes by the local Indians.

In the Okanagan system this whitefish is said to spawn about the middle of November.

ROUND WHITEFISH. *Prosopium cylindraceum quadrilaterale* (Richardson).
cylindraceum = like a cylinder.
quadrilaterale = four-sided.

Description.—Body trout-like, length up to 16½ inches, and weight up to 2 pounds. Mouth small, with no teeth. Nostril with a single flap between openings. Gillrakers, 16 to 20. Scales in 86 to 100 rows. Rays in anal fin, 11 to 13.

General colour silvery, with dark-bronze back. Parr marks are present in the young stages.

Distribution.—Northern Asia and northern North America from the Yenesei river in Siberia to New Brunswick and Maine.

In British Columbia the round whitefish is known to be present in Atlin lake, Lake Bennett, and Teslin lake.

Notes.—The round whitefish is fairly abundant in the northern lakes which form the headwaters of the Yukon river. It feeds on bottom organisms, much as does the common whitefish, but usually in somewhat shallower water. Spawning occurs in the autumn along the shore-line.

COULTER'S WHITEFISH. *Prosopium coulterii* (Eigenmann & Eigenmann).

coulterii = after Dr. J. M. Coulter, a well-known botanist.

Description.—Body trout-like, length up to 6½ inches. Mouth comparatively large, with no teeth. Nostril with a single flap between openings. Gill rakers, about 26. Scales in 59 to 64 rows. Rays in anal fin, 10.

Colour similar to other species.

Distribution.—Headwaters of the Columbia to Alaska.

In British Columbia Coulter's whitefish is known only by specimens taken in the Kicking Horse river at Field and Golden.

Notes.—Since the known range of this species has been extended to include both the State of Washington (Diamond lake, Stevens County) and Alaska (Second lake and Lake Aleknagik), it will likely be found in other British Columbia streams. Nothing seems to be known concerning its life-history.

COMMON WHITEFISH.
Lake Whitefish.
Eastern Whitefish.

Coregonus clupeaformis (Mitchill).
Coregonus = a name used for the European whitefish.
clupeaformis = herring-shaped.

Description.—Body deep and compressed. Length up to 24 inches and weight up to 23 pounds. Premaxillaries vertical or turned backward. Mouth small, with weak teeth. Nostril with two flaps between openings. Gill rakers, 20 to 29. Scales in 77 to 90 rows. Rays in anal fin, 13 to 16.

General colour silvery, with dark olive-brown back.

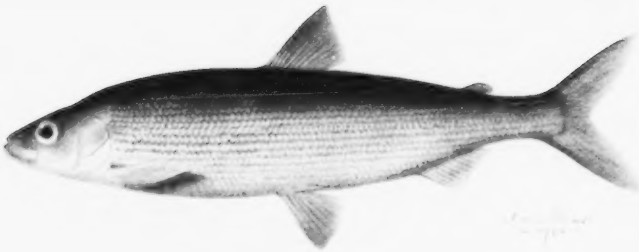
Distribution.—Northern New Brunswick and Great Lakes northwestward to Alaska.

In British Columbia the common whitefish is reported as occurring in the following bodies of water: Lake Lindeman, Atlin lake, Teslin lake (Yukon system); Swan lake (Peace-Mackenzie system); Babine lake, Bear lake, Morrison lake, Swan lake, Stephens lake (Skeena system); Fraser lake, Francois lake, Middle river, Driftwood river, Tetana lake (Fraser system). The species has also been introduced into Coquitlam, Harrison, Pitt, Deer, Hicks, Squakum, Morris, Cultus, Lillooet, Horseshoe, and Shuswap lakes (Fraser system); Shawnigan lake (Vancouver island); Okanagan, Kalamalka, Woods, Dog, Vaseaux, and Osoyoos lakes (Okanagan-Columbia system); and into Arrow and Kootenay lakes (Kootenay-

Columbia system). Records of survival, however, are known only for Shuswap lake and those of the Okanagan system.

Notes.—The common whitefish is a natural inhabitant of the northern portion of the Province. In Teslin lake two forms occur, known locally as the "sheep-nose" and the "hump-back." The former has a convex head profile and the latter a concave or straight head profile with a pronounced hump at the nape. These two forms occur throughout north-western America and have been given the names of *C. kennicotti* and *nelsonii* respectively, but Dymond (1943*a*) has failed to find any constant body characters by which to separate them satisfactorily from *C. clupeaformis*.

The common whitefish of southern British Columbia was introduced from eastern Canada with the idea of developing a commercial fishery in the larger lakes. However, the fish have not become abundant in any lake nor have they reached a large size, possibly because of a lack of sufficient food materials. An attempt in 1929 to operate a commercial fishery in Okanagan lake was not successful. The whitefish is a bottom feeder, consuming snails, small clams, insect larvæ, and worms; in Morrison lake (Skeena system) it appears to feed almost entirely on copepods (McMahon, 1948). It spawns in the autumn along the gravelly to rocky shores.



Cisco.
Lake Herring.

Leucichthys sardinella (Valenciennes).
Leucichthys = white, fish.
sardinella = small sardine.

Description.—Body trout-like. Length up to 12 inches and weight up to 2 pounds. Premaxillaries turned forward. Mouth small with weak teeth. Nostril with 2 flaps between openings. Gill rakers, 37 to 52. Scales large, in 71 to 97 rows. Rays in anal fin, 13 to 16.

General colour silvery, with grey or greenish back.

Distribution.—Mouths of Arctic rivers, which it enters at spawning time.

In British Columbia it is known from Atlin and Teslin lakes, headwaters of the Yukon river system.

Notes.—The cisco of Atlin and Teslin lakes represents populations confined entirely to fresh water. It is a plankton feeder and in turn is eaten by lake trout, inconnu, pike, and ling. Spawning apparently occurs in the autumn along gravelly beaches.

The American form was originally reported under the name *L. pusillus*.

INCONNU. *Stenodus leucichthys mackenzii* (Richardson).
Stenodus = narrow, tooth.
mackenzii = of the Mackenzie river.

Description.—Body elongate, compressed. Total length up to 59¼ inches and weight up to 63 pounds. Head long, somewhat pike-like. Premaxillaries turned forward. Mouth large, with weak teeth; nostril with a double flap: Gill rakers, 19 to 23. Scales, 97 to 107. Rays in anal fin, 15 or 16.

General colour silvery.

Distribution.—Yukon and Mackenzie river systems in America.

In British Columbia the inconnu is known only in Teslin lake, one of the headwater lakes of the Yukon river system.

Notes.—The inconnu is abundant in the Mackenzie river and fairly so in the Yukon. In the lower portions of these rivers the fish are apparently anadromous, entering brackish water for a period and proceeding up-stream in the autumn to spawn. The fish of Teslin lake are no doubt year-round residents there. The inconnu is a fish-eater. In Teslin lake the only food item identified was the cisco, but in the Mackenzie river pike, goldeye, stickleback, and ling have been reported. The fish is of considerable importance as a food fish for man and his dogs.

The subspecies *Stenodus leucichthys nelma* occurs in northern Asia.

THE GRAYLING. FAMILY THYMALLIDÆ.

Grayling are distinguished by the small mouth and the greatly developed, highly coloured dorsal fin. They frequent cold northern streams, chiefly in the Arctic watershed.

ARCTIC GRAYLING.

Thymallus signifer (Richardson).
Thymallus = an ancient name referring to the odour of thyme.
signifer = standard-bearer, referring to the high dorsal fin.

Description.—Body elongate and compressed. Length up to 18 inches and weight up to 2 pounds. Dorsal fin long and high, its base longer than the head. Scales in 88 to 90 rows. Adipose fin small.

Colour dark bluish on the back, grey on the sides and below; blue spots on sides and on dorsal fin where they are edged in red. Upper edge of dorsal bright red.

Distribution.—Streams of the Arctic watershed of North America.

In British Columbia grayling are known to be in Atlin lake, Teslin lake and their tributaries, Dease lake, and tributaries of the Peace river such as Finlay river, Parsnip river, Nation river, and Tupper creek.

Notes.—The Arctic grayling is a fish of clear, cold streams and lakes. It is sometimes found in association with Rainbow trout in

streams with gravelly bottom, but prefers pools with sandy or clayey bottoms. Its food consists largely of insects, both aquatic forms, such as larvæ of stone-fly, may-fly, and caddis-fly, and terrestrial species which accidentally fall upon the water's surface. Since grayling readily take an artificial fly and are excellent food fish, they are of considerable value to the sport fisherman.

THE SALMON, TROUT, AND CHARS.
FAMILY SALMONIDÆ.

The fishes of this group include the species which are of greatest importance to the commercial fisherman and to the sport fisherman. They are characterized by an unspecialized body shape, relatively small cycloid scales, and an adipose fin. The fins lack spiny rays.

The salmonids are cold-water fishes of the Northern Hemisphere. Many are anadromous, spending the greater portions of their lives in the sea and entering fresh water only to spawn.

The descriptions of the adult Pacific salmon refer to individuals in fresh water.

KEY TO THE SPECIES.

1 (10) Rays in anal fin, 12 to 19.

2 (7) Distinct black spots on back and caudal fin.

3 (4) Spots on back and caudal fin large; scales small, in first row above lateral line, 170 or more.
Pink salmon—*Oncorhynchus gorbuscha.*

4 (3) Spots on back and caudal fin small, irregular; scales moderate to large, in first row above lateral line fewer than 155.

5 (6) Black spots when present on caudal fin, usually on upper lobe only; pyloric cæca, 45 to 80.
Coho salmon—*Oncorhynchus kisutch.*

6 (5) Black spots on both lobes of caudal fin; pyloric cæca, 140 to 185.
Spring salmon—*Oncorhynchus tshawytscha.*

7 (2) No distinct spots on back or caudal fin, fine black speckling frequent.

8 (9) Rakers on first gill arch, 19 to 26; short, stout, smooth, widely spaced.

Chum salmon—*Oncorhynchus keta.*

9 (8) Rakers on first gill arch, 30 to 39; long, slender, rough, closely set.

Sockeye salmon—*Oncorhynchus nerka.*

Kokanee—*Oncorhynchus nerka kennerlyi.*

10 (1) Rays in anal fin, 8 to 12.

11 (26) Teeth on head and shaft of vomer (*see* Fig. 3); spots black (sparse in *Salmo salar*). (Spots may be faint if fish has been in salt water for some time.)

12 (17) Teeth usually present on back of tongue; red dash on under-side of lower jaw (conspicuous in fresh-water specimens, faint or absent in marine individuals).

13 (16) Scales in first row above lateral line less than 200.

14 (15) Body more or less terete; profuse black spots on head, body, and fins.

Coastal cut-throat—*Salmo clarkii clarkii.*

15 (14) Body moderately deep, compressed; black spots, few, scattered, more numerous toward caudal fin.

Yellowstone cut-throat—*Salmo clarkii lewisi.*

16 (13) Scales in first row above lateral line, 200 or more.

Mountain cut-throat—*Salmo clarkii alpestris.*

17 (12) No teeth on back of tongue; no red dash on under-side of lower jaw.

18 (19) Black spots on body large, many surrounded by halos.

Brown trout—*Salmo trutta.*

19 (18) Black spots on body small, without halos.

20 (25) Caudal peduncle stout; rays in anal fin, 10 or 11 usually, 9 or 12 occasionally; continuous red band, varying in width along side of body, always present in mature fish; usually spots on caudal fin.

21 (22) Fish of the coastal waters and coastal streams and lakes; scales in first row above lateral line usually 130 to 135.

Steelhead—*Salmo gairdnerii gairdnerii.*

22 (21) Fish of the interior streams and lakes.

23 (24) Fish of intermediate altitudes, frequently reaching large size; scales in first row above lateral line usually 135 to 150.

Kamloops trout—*Salmo gairdnerii kamloops.*

24 (23) Fish of high altitudes, seldom reaching 12 inches in length; scales in first row above lateral line usually 150 to 155.

Mountain Kamloops—*Salmo gairdnerii whitehousei.*

25 (20) Caudal peduncle slender; rays in anal fin, 9 usually, 8 or 10 occasionally; never continuous red band along side of body, seldom spots on caudal fin.

Atlantic salmon—*Salmo salar.*

26 (11) Teeth on head of vomer only (*see* Fig. 3); spots grey, yellow, orange, or red, never black.

27 (28) Prominent dark-green vermiculations on back and dorsal fin; reddish spots on sides of body surrounded by blue.

Speckled char—*Salvelinus fontinalis.*

28 (27) No vermiculations on back and dorsal fin.

29 (30) Body olivaceous with yellow, orange, or red spots on body nearly size of pupil of eye.

Dolly Varden char—*Salvelinus alpinus malma.*

30 (29) Body green, grey, or brown, with white to grey spots on body.

Great Lakes char—*Cristivomer namaycush.*

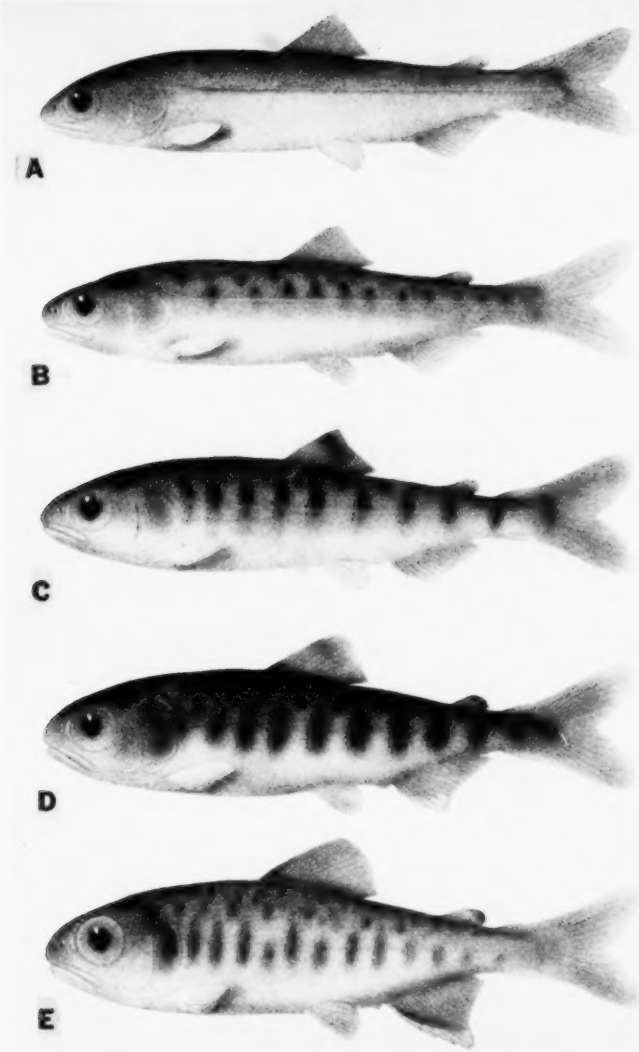


Fig. 6. Fry of Pacific salmon. *A*, pink salmon; *B*, sockeye salmon; *C*, chum salmon; *D*, spring salmon; *E*, coho salmon.

PINK SALMON.
Humpback Salmon.
(Breeding male.)

Oncorhynchus gorbuscha (Walbaum).
Oncorhynchus = hooked snout.
gorbuscha = the Russian vernacular name.

Description.—Body much compressed in spawning males, with prominent hump behind head; more rounded in spawning females. Length up to 30 inches and weight from 3 to 10 pounds. Jaws and teeth strongly developed in breeding males. Gill rakers on first arch, 26 to 34. Scales in first row above lateral line, 170 to 229. Rays in anal fin, 12 to 19. Pyloric cæca, 165 to 195.

Colour of breeding male, dark on back, red on sides and blotched with brown; black spots on posterior portion of back, on adipose and tail fin. Female less brilliant.

Distribution.—Pacific Coast, north from California to Alaska and westward to northern Japan.

In British Columbia pink salmon are found in all major streams and in many small streams of the coast during the spawning season.

Notes.—Pink salmon enter streams to spawn in the fall months, during September and October at McClinton creek in the Queen Charlotte islands and about the same time in the Fraser river. Egg-laying usually takes place at no great distance up-stream, although on the Skeena adult fish proceed as far as Babine river before spawning. The fry usually hatch in late February and emerge from the gravel during April and May, depending mainly on water temperatures; they migrate almost at once down-stream to the sea as free swimming fry.

Pink-salmon fry may be distinguished by the complete absence of parr marks, the sides having a clear and unbroken silvery sheen. The back is blue to greenish in colour and the belly silvery (*see* Fig. 6, *A*). They return to fresh water in the fall of the succeeding year as " 2-year-old " adults.

COHO SALMON.
Silver Salmon.
(Breeding male.)

Oncorhynchus kisutch (Walbaum).
kisutch = the vernacular name in Kamchatka

Description.—Body elongate, considerably compressed in males at spawning time. Length up to 36 inches and weight up to 26½ pounds. Average about 30 inches and 6 to 12 pounds. Jaws distorted and teeth strongly hooked, particularly in the male. Gill rakers on first arch, 19 to 25. Scales in first row above lateral line, 121 to 136. Rays of anal fin, 12 to 17. Pyloric cæca, 45 to 80.

Colour at spawning, bright red on sides, bluish-green on back and head, often dark on the belly. Female, less brilliant. Black spots, when present on caudal fin, usually on upper lobe only.

Distribution.—Pacific coast, north from San Francisco to Alaska and south on the Asiatic coast to Japan.

In British Columbia it ascends nearly all streams in which suitable spawning conditions are found.

Notes.—In the tributaries of innumerable coastal streams coho salmon spawn during November and December, and the fry begin

to appear in April. Coho fry may be distinguished from the young of other salmon and trout by the reddish-brown coloured tail and the white-edged anal fin, with the first few rays elongate giving the fin an extended pointed "corner" or trailing edge (*see* Fig. 6, *E*). They remain in fresh water for varying periods, the majority apparently migrating to the sea before the end of their first year of life. They return as adults in their third year, spawn and die.

In the commercial fishery coho salmon are very important (next to the sockeye in importance), and as a sport fish in coastal waters, they rank high, being taken by trolling with a spoon or plug and by casting, using a "buck tail" and other types of fly. However, once they enter fresh water they are no longer taken as food, except by the Indians who enjoy special privileges. Moreover, since they do not as a rule take a lure while in fresh water, they are of little interest to the sportsman above tidal influence.

SPRING SALMON. *Oncorhynchus tshawytscha* (Walbaum).
King Salmon. *tshawytscha* = the vernacular name in Kamchatka.
Tyee; Chinook.

Description.—Body elongate, deep and compressed, particularly in males at spawning time. Length up to 58 inches and weight up to 80 pounds (an individual 125 pounds has been taken). Average about 36 inches and 10 to 50 pounds (Cowichan river). Jaws strongly developed and teeth strongly hooked in breeding males. Gill rakers on first arch, 20 to 28. Scales in first row above lateral

line, 131 to 151. Rays of anal fin, 15 to 19. Pyloric cæca, 140 to 185.

Colour at spawning time, very dark, almost black on back and sides. Black spots usually present on back, dorsal fin, and both upper and lower lobes of tail fin.

Distribution.—Pacific coast, north from California to Alaska and south on the Asiatic coast to northern China.

In British Columbia spring salmon ascend all major streams. They also migrate up the Yukon river to spawn in tributaries of Bennett and Teslin lakes in northern British Columbia.

Notes.—Unlike cohoes, which spawn mainly in the small tributaries and often only a short distance from the sea, spring salmon commonly oviposit in the larger streams or larger tributaries of streams. The spawning season varies considerably from stream to stream, depending upon such conditions as distance from sea to spawning-ground. Springs usually appear in August and September, and egg-laying takes place during October and November.

The young go to sea very soon after emerging from the gravel or remain in fresh water for varying times up to fifteen months. Young spring salmon resemble young coho salmon in having long conspicuous vertical bars as parr marks, the bars extending about equally on either side of the lateral line. In general colour spring salmon are less brownish and the anal fin lacks the elongated first rays which are characteristic of young coho salmon (*see* Fig. 6, *D*). The major growth takes place in the sea, the fish becoming mature in from three to seven years. Males becoming sexually mature in their second or third years are commonly called "jacks."

Spring salmon are of great value both as a food and as a sport fish. Commercial fishermen take them by troll, purse seine, gill-net, and trap, and the sport fishermen by troll, as, for example, off Campbell river, where they constitute the widely known tyee fishing.

CHUM SALMON.
Dog Salmon.
(Breeding male.)

Oncorhynchus keta (Walbaum)
keta — a vernacular name in Kamchatka.

Description.—Body elongate and somewhat compressed. Length up to 38 inches and weights usually from 8 to 18 pounds. Jaws and teeth strongly developed in breeding males. Gill rakers on first arch, 19 to 26. Scales in first row above lateral line, 130 to 153. Rays of anal fin, 13 to 17. Pyloric cæca, 140 to 186.

Colour of breeding male, blackish above, brick red on sides, with greenish bars or mottlings. Female less brilliant.

Distribution.—Pacific coast, north from San Francisco to Alaska and south on the Asiatic coast to Kamchatka.

In British Columbia chum salmon ascend nearly all coastal streams, spawning generally at no great distance from salt water. On the other hand, they ascend the Yukon river to Teslin lake in British Columbia, travelling approximately 2,000 miles.

Notes.—Chum salmon may be found in the lower reaches of most coastal streams usually during October and November, commonly following the pink salmon, but seldom travelling far up-stream. The fry are long slender fish, usually dark mottled green on the back and silvery on sides and belly with a pale-green iridescence. From six to ten elliptical or oval parr marks are usually present, mainly above the lateral line (*see* Fig. 6, *C*). The fry migrate to

the sea shortly after emerging from the gravel, none being found in fresh water after June or July.

In the southern portion of their range in British Columbia chum salmon return to fresh water to spawn mostly in their fourth year, while in the Queen Charlotte islands and in the Skeena river they return mostly in their fifth year.

SOCKEYE SALMON.
Red Salmon.
Blueback Salmon.
(Breeding male.)

Oncorhynchus nerka (Walbaum).
nerka = a Russian name.

Description.—Body rather slender and compressed, particularly in males at spawning time. Length up to 33 inches; weight up to 15½ pounds, but usually from 3½ to 8 pounds. Jaws and teeth strongly developed and hooked in breeding males. Gill rakers on first arch, 30 to 39. Scales in first row above lateral line, 125 to 143. Rays of anal fin, 13 to 16. Pyloric caeca, 66 to 92.

Colour of breeding male, blood red on back, darker red on sides; under-parts whitish with numerous fine, dark dustings; head pale olivaceous green on top and sides; snout and sides of jaw dark, under-surface of jaw white; dorsal, adipose, and anal fins red, ventrals and pectorals darkish, red at base. Colour of breeding female about the same, but darker on sides.

Distribution.—Pacific coast, north from Klamath river, California, to Alaska and westward to Japan.

In British Columbia sockeye salmon ascend most coastal streams, particularly those which drain lakes.

Notes.—Adult sockeye salmon usually appear in the fall in streams on which there are lakes and pass through the lakes to spawn in the tributary streams. A few spawn along the shores of lakes and a few in streams on which there are no lakes.

The fry which appear in lakes and streams in the spring have silvery sides with no green iridescence; the back is uniformly olive to grassy green and lacks mottlings (*see* Fig. 6, *B*). The parr marks are evenly distributed and are placed mainly above the lateral line. Sockeye fry may be confused only with chum fry, from which they differ chiefly in being smaller in size, in lacking the green iridescence of the sides and the mottling on the back.

Young sockeye spend usually one, frequently two, and occasionally three years in fresh water, eventually passing to the ocean, where they mature. They return as adults after three or four summers in the sea, when they are thus 4 or 5 years of age. A few, for the most part males, mature at 3 years of age and are frequently referred to as grilse and sometimes "jacks." A few mature at 6 years of age and fewer still at 7 and 8 years.

The sockeye salmon is the most prized of the Pacific salmon because its high oil content, the colour of its flesh, and its rather uniform size make it an excellent fish for canning.

KOKANEE.
Kickininee.
Little Redfish.
Silver Trout.
(Breeding male.)

Oncorhynchus nerka kennerlyi (Suckley).
kennerlyi = after Dr. C. B. R. Kennerly of the North-west Boundary Commission's survey.

Description.—Identical with anadromous sockeye salmon except in size. Length at maturity very variable, 8 to 16 inches, depending upon habitat conditions.

Distribution.—In lakes throughout the range of the anadromous form.

In British Columbia kokanee are known to occur in many lakes in the southern portion of the Province, in Morrison lake of the Skeena system, and in the larger lakes of Vancouver island.

Notes.—Land-locked sockeye salmon appear in streams and along the shores of lakes in the fall for the purpose of spawning. At this time large numbers were formerly taken for food by Indians and whites, but restrictive measures have now been imposed under the Provincial Fisheries Act. At other than spawning time these fish occupy the open waters of lakes at intermediate depths and are not commonly seen, except when taken by anglers.

The food consists chiefly of small animal and plant organisms which are strained from the water by means of the numerous fine gill rakers; larger forms, such as insects, are sometimes taken. In turn the kokanee forms a very important article of food for Kamloops trout and other large fish.

COASTAL CUT-THROAT TROUT.

Salmo clarkii clarkii Richardson.

In some lakes, for example Lac la Hache, Christina lake, and Woods lake, kokanee are of some importance as a sport fish, readily taking a worm or a "fly" trolled behind a spoon. Specimens up to 4 pounds in weight have been so taken. In the State of Washington they are called "silver trout" and are caught in large numbers by anglers in certain bodies of water.

Two types of fresh-water sockeye salmon have been recognized, "residual sockeye" and "kokanee." The first named are offspring of sea-going sockeye, while the second are descended from other kokanee. The two kinds differ slightly in size, colour, and time of spawning, as shown by Ricker (1940).

COASTAL CUT-THROAT TROUT. *Salmo clarkii clarkii* Richardson.

Salmo = the Latin name for the salmon of the Atlantic.

clarkii = after Capt. William Clark of the Lewis and Clark expedition.

Description.—Body typically trout-like. Length up to 30 inches and weight up to 17 pounds. Teeth on back of tongue; red colour under lower jaw. Jaw long, extending well behind vertical through posterior margin of eye. Scales in first row above lateral line in 143 to 180 rows (usually 150 to 158), oblique rows 170 to 200. Rays in anal fin, 8 to 12.

Colour dark green above, olive-green on sides, silvery below. A pinkish sheen on gill covers; a red streak between lower jaw and isthmus on either side. Numerous small dark star-shaped spots on back and sides well below the lateral line; rounded spots on head, dorsal, adipose, caudal, and anal, and on bases of paired fins. In fresh-run fish from the sea the ground colour tends to bluish and the sides have a pronounced silvery sheen.

Distribution.—From northern California north through British Columbia to south-eastern Alaska.

In this Province the coastal cut-throat is found in practically all the streams and lakes of the coastal region.

Notes.—Cut-throats spawn in small streams usually during the period from February to May, the time depending upon local

conditions. In the Cowichan system ripe individuals have been taken in November and December, but the majority appear to spawn in February and March. Egg-laying apparently takes place at night.

Young cut-throats bear parr marks as do other trout, but may be distinguished by the long jaw and presence of teeth on the back of the tongue. They remain in fresh water for varying periods; some enter the sea when quite small; others apparently remain indefinitely in lakes and streams.

The food items utilized by cut-throat trout appear to vary with the size of the fish. In the Cowichan river those less than 6 inches in length feed almost entirely on insects; larger trout also take fish, principally sticklebacks and kokanee. During the salmon-spawning season, eggs are also taken by cut-throat trout. In general this species consumes more fish than do other species of trout.

To the sportsman the cut-throat is of great value as a game fish, but is not the equal of the steelhead, rainbow, or Kamloops in fighting ability.

Hybrid trout obtained by artificially crossing cut-throats with rainbows have been planted in certain waters in the Cranbrook area. These trout are referred to as "Cranbrook" trout.

YELLOWSTONE CUT-THROAT TROUT.
Montana Black-spotted Trout.

Salmo clarkii lewisi (Girard).
lewisi = after Capt. Meriwether Lewis of the Lewis and Clark expedition.

Description.—Body deeper and more compressed than in coastal cut-throat. Length up to 12 or more inches. Scales in first row above lateral line in 150 to 175 rows (usually 165).

Colour yellowish-green with red on sides of head and front portion of body. A red streak between lower jaw and isthmus on either side. A few scattered spots on top of head and front part of body above the lateral line; spots from dorsal fin backward more numerous, extending to lower surface behind anal fin. Lower fins unspotted.

Distribution.—Middle and upper Columbia river system; Yellowstone lake and upper Missouri river system.

In British Columbia Yellowstone cut-throat trout are found in the upper waters of the Kootenay river, including the basins of the

YELLOWSTONE CUT-THROAT TROUT.

Salmo clarkii lewisi (Girard).

Moyie and Elk rivers in the south-east portion of the Province. They have also been planted in Magog, Sunburst, Cerulean, and Wedgewood lakes in the Mount Assiniboine park area, and for some years were widely distributed in coastal waters in fish-cultural activities.

Notes.—The Yellowstone cut-throat is found in most lakes within its natural range and also in streams, where it prefers rocky pools or back-eddies in swifter water.

"Spawning in this area usually occurs about the middle of April. Males are sexually mature at eight inches, and females at ten and a half inches in length. A ten-ounce fish produces about five hundred eggs, a pound and a half fish about one thousand. The eggs are buried about two inches deep in the gravel of small streams.

"These cut-throats are similar in their game qualities to their relatives in coastal waters. As they occur in most waters in good numbers, and generally take the fly quite readily there is much sport to be had in angling for them."—Dymond, 1932, p. 32.

MOUNTAIN CUT-THROAT TROUT. *Salmo clarkii alpestris* Dymond. *alpestris* = of mountains.

Description.—Head shorter, body deeper and wider, caudal peduncle deeper, pectoral and ventral fins longer, and eyes larger than in coastal cut-throat. Length up to 14 inches. Scales in first row above lateral line in 200 to 230 rows (usually 218).

Colour dark brownish on back and upper sides, lighter below; under-parts greyish. Pinkish on gill covers and pink streak often along sides. A red streak between lower jaw and isthmus. A few scattered spots over the front part of body both above and below the lateral line. Larger and more numerous spots backward from region of dorsal fin and extending to lower surface behind anal fin; ventral and pectoral fins unspotted.

Distribution.—Headwaters of mountain streams in central British Columbia.

Mountain cut-throat trout are known to occur in Crazy, Yard, and Frog creeks, tributary to Eagle river and Mabel lake, and in some small lakes on Mount Griffin (Fraser system); in "Isaac" (Akolkolex?), "Frog," and Kirkup (Canyon) creeks near Revelstoke (Columbia system); and in Duhamel (Six Mile) and Lasca

(Nine Mile) creeks flowing into the West arm of Kootenay lake (Kootenay-Columbia system).

Notes.—J. R. Dymond, who described this form of cut-throat trout (1931), points out that this fish occurs in the central area of the Province where the Kamloops is the common trout, but the cut-throats are found only in a few isolated localities, usually in headwaters of mountain streams where they are cut off by impassable falls. Some are also found in streams which do not contain insurmountable falls, which suggests that these particular localities are more suited for the cut-throat than for the Kamloops.

Fish taken near Revelstoke in August and September had eaten mostly insect material, of which half consisted of larval aquatic insects and the remainder adults taken on the surface.

As a game fish mountain cut-throats are the equal of the coastal forms; they rise readily to an artificial fly and put up a gamey fight.

BROWN TROUT.
Loch Leven Trout.

Salmo trutta Linnaeus.
trutta = trout.

Description.—Body typically trout-like. Length up to 24 inches and weight up to 5 pounds (Cowichan river). Teeth and hooked snout strongly developed in breeding males. Scales in the first row above lateral line, 115 to 150 (116 to 136 oblique rows).

General ground colour golden brown with dark brown or black spots on body, dorsal, adipose, and tail fin. Some body spots edged

STEELHEAD TROUT.

Salmo gairdnerii gairdnerii Richardson.

Young in fresh water.

posteriorly with orange; some spots below lateral line edged with pink or red, forming halos. Colours most brilliant in the spawning male.

Distribution.—Streams of western Europe and British Isles; introduced into New Zealand, Africa, and America.

In British Columbia brown trout have been introduced into the Cowichan and Little Qualicum rivers, Vancouver island.

Notes.—Plantings of this foreign game fish were made in the Cowichan and Little Qualicum river systems during the period 1932 to 1935, inclusive. The eggs were purchased from Wisconsin and Montana by the Dominion Department of Fisheries. Brown trout are now well established in the Cowichan river system, the first-observed spawning run being noted in 1937, but as yet they form a negligible proportion of the angler's catch, even where they are most plentiful. In the Little Qualicum system the species has also become established, but its numbers are small, judging from the angling results. Although brown trout have been taken in tidal portions of both rivers, there is as yet no direct evidence that this species has entered the sea.

In the Cowichan river brown trout up to 4 inches in length feed primarily upon insects; larger fish also take insects, mostly caddis-fly larvæ, and in addition prey upon young salmon and other fishes to a considerable extent (Idyll, 1942).

Some of the early introductions into America were from Loch Leven, Scotland, which is occupied by a special race of brown trout. For this reason brown trout in America are often called Loch Leven trout, but it is impossible that any pure strains of the Loch Leven race persist.

STEELHEAD TROUT.
Rainbow Trout.

Salmo gairdnerii gairdnerii Richardson.
gairdnerii = after Dr. Gairdner, a naturalist in the employ of the Hudson's Bay Company.

Description.—Body typically trout-like. Length up to 45 inches and weight up to 36 pounds. No teeth on back of tongue, no red colour under lower jaw. Teeth and hooked snout strongly developed in breeding males. Scales in first row above lateral line, 130 to 135 (115 to 159 oblique rows).

Colour of back and upper sides greenish; a pinkish-bluish stripe along lateral line and on gill cover; belly silvery. Numerous small dark spots on body mainly above lateral line and on dorsal adipose and caudal fin; remaining fins are whitish or dusky. At spawning time, especially in males, the belly and lower fins become darker and the pink streak becomes a deep-reddish band.

Distribution.—California, north through British Columbia, to south-eastern Alaska.

In British Columbia steelhead trout are found at certain seasons in most of the larger streams of the coast.

Notes.—Steelheads move into streams from the sea more or less at regular intervals, but not always for the purpose of spawning. The time of run varies from stream to stream, depending upon local conditions and perhaps upon the habits of the population of fish concerned. In the Cowichan system the first fish of the "winter run" usually appear in December, and fish may be found throughout the following months until the end of April. Egg-laying usually takes place during January, February, and March on the gravel-bars in the Cowichan river and in the larger tributaries flowing into the lake. After spawning the adults gradually move down-stream to the sea, possibly to return and spawn again another year.

The young remain in fresh water at least one year. In the Cowichan many reach the sea at the beginning of their second or third year of life. They return to spawn after a residence of at least eighteen months in the sea. Spawning individuals are usually in their third, fourth, fifth, or sixth year of life.

In the Cowichan river and possibly in most other coastal rivers of the Province there is a type of trout of this species which remains permanently in fresh water. These non-sea-going fish are commonly called "rainbow trout," which is a useful name to distinguish them from the anadromous "steelhead." Recent study (Neave, 1944) has shown that these two types differ in average scale count as well as in migratory habits.

The food of rainbow trout in the Cowichan system is largely made up of insects, chiefly caddis-flies and black-flies. Trout in the lake occasionally take fish, and those in the river eat salmon-eggs to some extent when they are available.

KAMLOOPS TROUT.

Salmo gairdnerii kamloops Jordan.

Coloration of medium-sized fish in rivers and small lakes.

The young of both steelheads and rainbows may be distinguished from the young of salmon by the presence of no more than 12 rays in the anal fin. They may be distinguished further from young of cut-throat trout by the short head and jaw and usually by the lack of teeth on the back of the tongue.

Both steelhead and rainbow trout are of great importance in the sport fishery of the Province.

KAMLOOPS TROUT. *Salmo gairdnerii kamloops* Jordan.
kamloops = originally from Kamloops lake.

Description.—Body typically trout-like, often very deep. Length up to 36 inches and weight up to 52½ pounds (Jewel lake). No teeth on back of tongue; no red colour under lower jaws. Teeth and hooked snout strongly developed in breeding males. Scales in first row above lateral line, 135 to 150.

Colour very variable according to size and habitat. Back and upper sides bluish (large lakes) or greenish (streams); side and belly silvery (non-breeding or immature fish) or with red lateral band and dark coloration (breeding fish); heavy dark spots present on back, upper sides, dorsal, adipose, caudal, and base of anal fins (immature fish in shallow water). Lower fins whitish or slightly clouded (non-breeding); tips of ventral and anal fin cream-coloured (breeding). Usually 9 or 10 dark-bluish blotches or parr marks on sides and orange tips to anal and ventral fins in small fish (up to 12 inches in length).

Distribution.—North-eastern Washington and interior of British Columbia.

In this Province Kamloops trout are found throughout the Fraser system above Hell's Gate and throughout most of the Columbia basin, except in that portion drained by the Moyie, Elk, and part of the upper Kootenay rivers. Outside of their natural range they have been extensively introduced through fish-cultural activities.

Notes.—Kamloops trout spawn in creeks a short distance above the lake or in outlet streams quite close to the lake. In large lakes some spawning may take place on the beaches near in-flowing streams. The time of spawning varies with the locality and the season, but is usually soon after the ice breaks up in May or June.

The young trout may enter the lake during their first year of life or may remain indefinitely in streams. Those which spend the greater part of their life in lakes grow more rapidly and reach a larger size than those in streams, often attaining a length of 27 inches and a weight of 8 pounds in their fifth year. Trout in streams of small size and containing little food may scarcely attain 8 inches in length at maturity.

The types of food-organisms taken vary with the season and with the size of the fish. In general, small fish eat small organisms such as water-fleas and insect larvæ, while large fish eat larger items such as leeches, large insects, molluscs, and fish (usually kokanee).

As a sport fish the Kamloops trout ranks high. It may be taken on a variety of tackle and is sometimes more than a match for the most skilful angler.

MOUNTAIN KAMLOOPS TROUT. *Salmo gairdnerii whitehousei* Dymond. *whitehousei* = after F. C. Whitehouse, of Vancouver, who discovered the race.

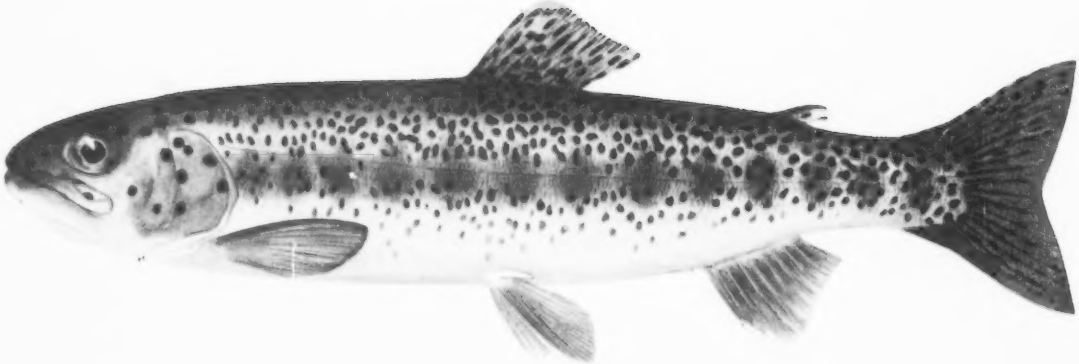
Description.—Body trout-like but slender. Length seldom more than 12 inches. No teeth on back of tongue; no red colour under lower jaw. Scales in first row above lateral line in 150 to 155 diagonal rows.

Colour olive-green above, fading to yellowish-green on lower sides; pale on belly. A reddish lateral band from gill cover to base of tail, overlaid by about 13 bluish parr marks. Many dark spots on head, back, sides, and on dorsal, adipose, and caudal fins. A conspicuous orange tip to dorsal fin; a whitish tip to ventral and anal fins.

Distribution.—Small lakes at high altitudes in the Selkirk mountains.

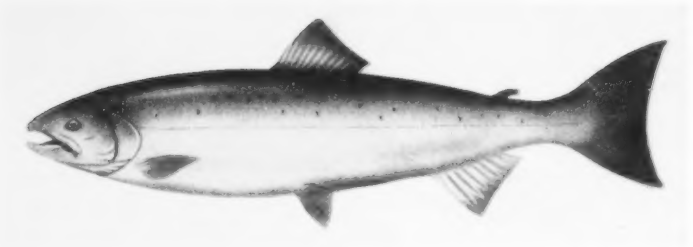
Mountain Kamloops trout are known chiefly from Six Mile lake and Cottonwood lake near Nelson, and from Bear and Fish lakes near Kaslo.

Notes.—Little detailed information concerning this diminutive game fish is available. Mr. F. C. Whitehouse, who first recognized and collected this subspecies, reports that this fish spawns in creeks in mid-June.



MOUNTAIN KAMLOOPS TROUT.

Salmo gairdnerii whitehousei Dymond.



ATLANTIC SALMON. *Salmo salar* Linnaeus.
salar = to leap.

Description.—Body much like that of steelhead. Length up to 48 inches and weight up to 50 or more pounds (in native habitats). About 11 rays in dorsal fin; 9 rays in anal fin, 8 or 10 occasionally. Scales in 120 to 125 rows.

Colour in the sea, silver with steel-blue on back; scattered rounded or X-shaped black spots on sides extending below the lateral line. Dorsal, caudal, and pectoral fins, dusky; ventrals and anal, white. In fresh water the colours are duller and more muddy. Fresh-run males may have orange or red marks.

Distribution.—North Atlantic, ascending all suitable streams in northern Europe and in North America north of Cape Cod. Introduced into New Zealand and various parts of western North America.

In British Columbia Atlantic salmon have been introduced into many water systems.

Notes.—Atlantic salmon were first introduced into British Columbia in 1905, when 90,000 fry resulting from eggs brought from the Canadian Atlantic coast were distributed to Coquitlam river, Lillooet river, and Harrison lake on the mainland, and to Campbell river, Comox lake, Horne lake, Nanaimo lake, Cowichan lake, and Koksilah river on Vancouver island. In subsequent years more plantings were made in some of these bodies of water and in others such as Shawnigan lake (Vancouver island), White lake ("She-whap-mah peninsula"), Granite creek, Edith lake, and LeBois lake (Kamloops), and

Kootenay lake, but the only large-scale stocking programme concerned the Cowichan river system, which was then judged to be most suitable for this species. In this latter experiment, eggs were imported from the Canadian Atlantic coast, as well as direct from Scotland.

In spite of these extensive introductions, which were continued until 1933, Atlantic salmon have apparently failed to become established. There have been several reports of specimens being taken in the Cowichan river, but there appear to be only two or three authenticated records. Dymond (1932) says of two specimens examined by him, "One had been taken in Cowichan Lake, September 3, 1913; it was less than six inches long. The other, eleven inches in length and nine ounces in weight, was taken in the Lower Cowichan River on May 31, 1926." A third specimen from an unknown locality and dated "April 1, 1914," is in the Pacific Biological Station collection.

SPECKLED CHAR.
Eastern Brook Trout.

Salvelinus fontinalis (Mitchill).
Salvelinus = an old name for char.
fontinalis = living in springs.

Description.—Body, trout-like. Length up to 34 inches and weight up to 5 or more pounds (14½ pounds in the Nipigon river, Ontario). Vomerine teeth on head of vomer only. Scales in about 230 rows; 9 rays in the anal fin.

General colour olive-green; darker on back, lighter on sides. Dark worm-like marks (vermiculations) on back and dorsal fin.

DOLLY VARDEN CHAR.

Salvelinus alpinus malma (Walbaum).

On sides, many small greenish spots, some with red centres bordered with blue. Caudal and lower fins pinkish; lower fins edged with white on front margin.

Distribution.—Streams and lakes of north-eastern North America; introduced in the west.

On the mainland of British Columbia speckled char have been widely introduced and are known to occur in many streams and lakes in the southern interior. On Vancouver island they are present in the upper reaches of the tributaries to the Cowichan river system and in Spectacle lake (Malahat district). They are also reported to be present in Somenos lake and Round lake (near Duncan).

Notes.—Speckled char thrive best in cold, clear streams, where they subsist mainly on insects. Large individuals also feed upon fish to some extent. In this Province the species has often been introduced into slow-moving streams and shallow lakes, where they have become somewhat sluggish in habit. Nevertheless, in certain lakes and streams of south-eastern British Columbia this game fish provides a sport fishery of some importance. On Vancouver island this char has not flourished, except in Spectacle lake where an egg-collecting station was operated for some years.

Spawning takes place in the fall. A nest is constructed and eggs are deposited in gravelly streams, much as in the case of salmon and trout, and the fry emerge the following spring.

DOLLY VARDEN CHAR.
Bull Trout.

Salvelinus alpinus malma (Walbaum).
alpinus = alpine.
malma = a vernacular name in Kamchatka.

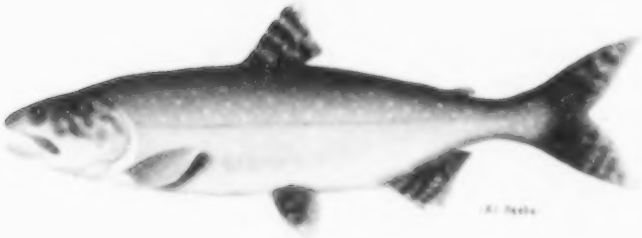
Description.—Body trout-like. Length up to 36 inches and weight up to 20 pounds. Vomerine teeth on head of vomer only. Scales in 190 to 250 rows (average 220); 9 rays in anal fin.

General colour plain olivaceous, with many round orange or reddish spots nearly as large as the pupil of the eye. Pectoral, ventral, and anal fins often with whitish anterior border. In sea-run individuals the colour is more silvery with pale or no spots.

Distribution.—Northern California north to Alaska and waters of Kamchatka.

In British Columbia the Dolly Varden is generally distributed, apparently occurring in all river systems except the Okanagan, as well as in the sea.

Notes.—The Dolly Varden has some value as a sport fish, but it has not the fighting qualities of trout of equal size. In habit it is rather sluggish, usually keeping well to the bottom, where it feeds on other fishes as well as on food items such as crustaceans and aquatic insects commonly utilized by the more desirable trout. The Dolly Varden does not rank high in the esteem of sport fishermen.



GREAT LAKES CHAR.
Lake Trout.
Grey Trout.

Cristivomer namaycush (Walbaum).
Cristivomer = crested vomer (in roof of the mouth).
namaycush = an Indian name.

Description.—Body, trout-like. Length up to 47 inches and weight up to 60 pounds. Vomerine teeth on head of vomer only. Scales in 185 to 205 rows; 11 rays in anal fin. Tail fin deeply forked.

General colour greenish, greyish, or brownish, with many light spots on sides and back and also on dorsal, adipose, and caudal fins.

Distribution.—Northern North America from Labrador to Alaska; south to northern New York and New England states.

In British Columbia Great Lakes char are present in most deep lakes from Shuswap lake northwards. They are known to occur in

the following: Shuswap, Victor, Three Valley, Griffin, Canim, La Hache, Fraser, Stuart, Francois (Fraser system); Morrison, Morice, Babine, Bear (Skeena system); Bennett, Tagish, Atlin, Teslin, Summit (Yukon system). The species appears to be absent from the Columbia system and from Vancouver island.

Notes.—Lake "trout" are more correctly called char, since they belong to the same group of fishes as the Dolly Varden char and the speckled char or brook "trout." They are cold-water fish frequenting relatively deep lakes. They may be taken on a troll in relatively shallow water in some lakes or at considerable depth in others, using several hundred feet of metal line fitted with a relatively heavy weight and spoon, but under these conditions the fish cannot fight to any great extent.

At Lac la Hache, lake char are sometimes "skated down" under the ice and captured by spearing. This is possible only when the ice is clear and fairly thin, conditions under which fish can be seen in water up to 20 feet in depth. When a fish is sighted, one or two skaters approach the fish from the deep-water side and slowly drive it into shallower water. When the fish appears to be travelling in a favourable direction, a third person quickly chops a hole in the ice at a point some distance in front of the fish. The victim is then easily speared as it slowly passes the hole. Char up to 40 pounds in weight have been taken in this manner.

The lake char preys upon fishes such as kokanee, whitefish, and ling while in deep water. During the spring and fall, when in shallow water, aquatic insects and shore-dwelling minnows are eaten.

Lake char spawn during the fall months on reefs or gravelly bottom in relatively shallow water. They are not known to migrate to the sea.

THE SUCKERS. FAMILY CATOSTOMIDÆ.

Suckers are characterized by having a subterminal mouth so constructed that it can be protruded for feeding on the bottom. There are no teeth on the jaws, but pharyngeal teeth are present. Members of this family are largely confined to North America, where they are widely distributed; at least two species are found in China and Siberia.

KEY TO THE SPECIES.

1 (2) Scales small, more than 90 in lateral line; head long, pointed.
Fine-scaled sucker—*Catostomus catostomus.*

2 (1) Scales large, less than 80 in lateral line; head short, blunt.

3 (4) Scales 65 to 75 in lateral line; upper lip with 6 to 8 rows of papillæ; dorsal rays, 13 to 15.
Coarse-scaled sucker—*Catostomus macrocheilus.*

4 (3) Scales 64 to 70 in lateral line; upper lip with 2 or 3 rows of papillæ; dorsal rays, 11 or 12.
White sucker—*Catostomus commersonnii.*

FINE-SCALED SUCKER.
Long-nosed Sucker.
Northern Sucker.

Catostomus catostomus (Forster).
Catostomus = inferior mouth (beneath the snout).

Description.—Body elongate, almost cylindrical in section. Average length from 14 to 18 inches. Head flattened on top; snout elongated and overhanging mouth. Lips thick, with coarse tubercles. Scales small, 95 to 114 along the lateral line, much crowded toward the head. Dorsal short (base shorter than vertical height); 10 or 11 rays. Breeding males with tubercles on head and anal fin; occasionally on tail fin.

Colour olivaceous; males with a broad rosy band on each side at spawning time.

Distribution.—Great Lakes, upper Missouri, upper Columbia and north-westward to Alaska.

In British Columbia the fine-scaled sucker is known to be present in the Columbia drainage system (Kootenay-Okanagan); in the Fraser river system (Shuswap, Lac la Hache, Ootsa, Driftwood, Blue, Chilcotin, Chilko, Choelquoit, Trembleur); in the Skeena river system; and in northern British Columbia (Teslin lake). It is probably also present in some of the other river systems such as the Nass.

Notes.—The fine-scaled sucker is locally abundant and usually occupies somewhat deeper water than do the coarse-scaled and white suckers; its food consists of bottom organisms such as snails, crustaceans, insect larvæ, and worms. It ascends small tributaries in early spring to spawn (during April at Lac la Hache). Driftwood Valley Indians used to use this sucker as bait for the Great Lakes char. In the eastern portion of its range it is often used as a food fish.

A subspecies, *Catostomus c. lacustris* Bajkov, has been reported from Garnet Valley lake near Summerland and also from Annette lake, Jasper park, but additional specimens should be obtained from the former locality for further study.

COARSE-SCALED SUCKER.
Columbia River Sucker.

Catostomus macrocheilus Girard.
macrocheilus = large lip.

Description.—Body elongate, almost cylindrical in section. Average length from 12 to 18 inches. Head rounded on top; snout blunt, but overhanging mouth. Lips thick, with moderate to coarse tubercles or papillæ in 6 to 8 rows. Scales large, 65 to 75 along

the lateral line; crowded toward head. Dorsal long (base almost twice vertical height); 13 to 15 rays. Breeding males with tubercles on anal fin and lower portion of tail fin.

Colour dark olivaceous, occasionally with a dusky lateral stripe; abruptly pale below.

Distribution.—Skeena, Fraser, and Columbia systems, Puget sound drainage, coasts of Washington and Oregon; east at least to headwaters of Salmon river, Idaho, and south at least to Sixes river, Oregon.

In British Columbia the coarse-scaled sucker is widely spread in lakes and streams of the Fraser and Columbia systems, and occurs in Lakelse lake of the Skeena system.

Notes.—Coarse-scaled suckers are often abundant, particularly around weedy margins of lakes, in backwaters, and in the mouths of streams. Here they feed upon a variety of foods, both among the plant growth and on the bottom. Small fish subsist chiefly on water-fleas, copepods, and aquatic insect larvæ mixed with small quantities of bottom ooze containing living plants (diatoms, etc.) and plant remains. Larger fish consume large numbers of crustaceans, insect larvæ, molluscs, and other organisms associated with the bottom, together with quantities of detritus. Occasionally fish-eggs are taken. Since suckers compete to some extent with game fish for food and since they may also feed upon fish-eggs, their presence in waters containing food or game fish may be undesirable. On the other hand, game species may feed upon young suckers. If it is found desirable to reduce the population of suckers in a lake, large numbers may be removed by placing traps in tributary streams up which the suckers run each spring to spawn.

In the region of Lac la Hache the spawning run is said to take place in May, following the run of fine-scaled suckers in the same streams.

Coarse-scaled suckers are of some commercial value as food in Washington and Oregon, but are seldom used in this Province, except for feeding fur-bearing animals.

WHITE SUCKER. *Catostomus commersonnii* (Lacépède).
commersonnii = after P. Commerson, an early French naturalist.

Description.—Body elongate, almost cylindrical in section. Average length from 12 to 18 inches. Head flattish on top; snout blunt, scarcely overhanging mouth. Lips thick, with coarse tubercles in 2 or 3 rows. Scales moderate, 64 to 70 along the lateral line; crowded toward head. Dorsal long (base almost twice vertical height); 11 to 12 rays. Breeding males with tubercles on anal fin and lower portion of tail fin.

Colour variable, generally olivaceous; darker at spawning time. Breeding males may have dark lateral band above one of salmon or rose colour. Under-parts creamy white.

Distribution.—North America east of the Rocky mountains, from the Mackenzie system in northern Canada east to Labrador and south to the Gulf States.

In British Columbia the white sucker is known from Charlie creek, Tupper, Meadow, Stoddart, and Pouce-Coupé rivers (Peace-Mackenzie system).

Notes.—The white sucker is the common species of eastern North America where it is widely and extensively used as food. It is also thought to be of considerable value as a forage fish, supplying a natural food for many species of game fishes. Like the coarse-scaled sucker, it is a shallow-water inhabitant and a bottom feeder.

In the Peace River district of British Columbia this fish is also of some importance as food for man. Spawning takes place in streams about the middle of May.

THE MINNOWS. FAMILY CYPRINIDÆ.

This family is composed of a great number of fishes, usually of small size; many do not exceed a few inches in total length, but some, such as the carp and squawfish, may attain a considerable size, up to 50 pounds in the case of the former. All are provided with well-developed pharyngeal teeth, but lack the adipose fin. Only a few species of minnows are found in British Columbia. With the exception of the chub (*Mylocheilus*) and one Japanese species which occasionally enter the sea, all are confined to fresh water.

KEY TO THE SPECIES.

1 (4) Spines in both dorsal and anal fins.

2 (3) Two pairs of barbels on side of upper jaw; scales on lateral line more than 32.
Carp—*Cyprinus carpio.*

3 (2) No barbels on side of upper jaw; scales on lateral line fewer than 30.
Goldfish—*Carassius auratus.*

4 (1) No spines in dorsal and anal fins.

5 (6) Over 100 scales along lateral line.
Golden Trench—*Tinca tinca.*

6 (5) Less than 100 scales along lateral line.

7 (8) Pharyngeal teeth in main row, blunt, molar-shaped in adults, often slightly hooked in young but never tapering evenly to a hooked point.
Chub—*Mylocheilus caurinus.*

8 (7) Pharyngeal teeth in main row hooked and usually compressed, tapering to a more or less hooked point; never blunt and always without a grinding surface.

9 (16) A small barbel on or near the posterior angle of maxillary.

10 (15) Premaxillary protractile; snout not long, pointed; mouth terminal.

11 (14) Barbel slightly anterior to posterior end of maxillary.

12 (13) Scales, 54 to 65 on lateral line; teeth, 2,4–4,2.
Lake Chub—*Couesius plumbeus greeni.*

13 (12) Scales, 60 to 72 on lateral line; teeth, 2,5–4,2.
Northern Minnow—*Margariscus margarita nachtriebi.*

14 (11) Barbel at posterior end of maxillary.
Silvery-grey Minnow—*Rhinichthys falcatus.*

15 (10) Premaxillary not protractile; snout long, pointed; mouth subterminal.
Long-nose Dace—*Rhinichthys cataractæ.*

16 (9) No barbel on or near posterior angle of maxillary.

17 (22) Anal rays, 7 to 10.

18 (19) Head long, pointed; maxillary reaching to point below eye.
Squawfish—*Ptychocheilus oregonensis.*

19 (18) Head short; maxillary not reaching to point below eye.

20 (21) Lateral line short or wanting.
Redbelly Dace—*Chrosomus eos.*

21 (20) Lateral line complete.
Northern Minnow—*Margariscus margarita nachtriebi.*

22 (17) Anal rays, 11 to 22 (usually 16).
Redside Shiner—*Richardsonius balteatus.*

CARP. *Cyprinus carpio* Linnaeus.
Cyprinus = the ancient name for the carp.
carpio = carp.

Description.—Body robust and compressed. Length up to 22 inches or more. Head short, snout rounded. Upper jaw with two barbels on each side. Scales large, in about 38 rows. Dorsal fin base long, with about 20 soft rays preceded by a stout, toothed spine. Anal with 5 soft rays preceded by a stout, toothed spine.

Colour dusky greenish to brownish on back and sides, yellowish on lower sides and belly. Lower fins reddish.

Distribution.—Temperate portions of Asia, particularly China. Introduced in Europe and America. Now widespread through eastern North America, Great Lakes region, Lake Winnipeg, and portions of the Pacific coast.

In British Columbia carp are known to occur in, or are reported to be present in, the following bodies of water: Okanagan, Kalamalka, Woods, Swan, Duck, Otter, Dog, Vaseaux, Osoyoos, Arrow, Twin, Horne, and Christina lakes (Columbia system); Mara, Rosemond, Shuswap, and Griffin lakes, Thompson river at Kamloops, Popkum creek near Chilliwack, and Hatzic lake (Fraser system); and in Glen lake, near Victoria, Vancouver island.

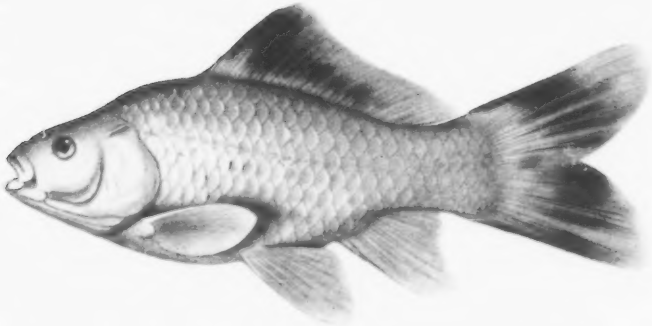
Notes.—The carp now found in the Okanagan valley probably originated from the State of Washington, where they were first

introduced in 1882. Clemens (1939) gives 1917 as the probable year when carp first appeared in Okanagan lake. Those in the Shuswap lake region were first noted about 1928. It is locally believed that they entered this region through natural creek-courses or irrigation-ditches near Armstrong, where the divide separating the two great watersheds is of very low elevation. Specimens taken in Popkum creek near Chilliwack in 1939 or 1940, in Hatzic lake in 1944, and one individual off Point Grey in brackish water on June 7, 1946, indicate that carp have made their way down the Fraser system to the coast.

The carp on Vancouver island are said to have been introduced into a swampy pond adjoining Glen lake more than forty years ago. Those in the lake may have been planted at the same time or may have escaped from the pond to the lake by way of drainage-ditches.

The food of carp in Okanagan lakes was found to consist largely of bottom organisms such as crustaceans, larvæ and nymphs of aquatic insects, worms, small snails, algæ, and plant fragments. They evidently consume large quantities of the basic food materials, and since they are little eaten by other species and are not used for commercial or sport purposes, they do not appear to contribute to the economic productivity of any lake.

The largest carp caught by fair angling in the British Isles up to 1933 weighed 26 pounds. In a lake near Seattle, Washington, a carp weighing 50 pounds was taken some years ago and one of 45 pounds was caught in Columbia slough, Oregon, in 1925 (Lampman, 1946).



GOLDFISH. *Carassius auratus* (Linnaeus).
Carassius = the European Crucian carp.
auratus = gilded.

Description.—Body robust and compressed. Length possibly up to 12 inches. Head short, snout rounded. Mouth terminal, without barbels. Scales large, in about 26 rows. Dorsal fin with long base; about 18 soft rays preceded by a spinous ray, serrated behind. Anal with 5 soft rays also preceded by a spinous ray.

Colour olivaceous or brownish; often orange, reddish, or variegated.

Distribution.—Native to eastern Asia; widely introduced elsewhere. In North America, sporadically through the Great Lakes drainage-basin and other ponds and streams.

In British Columbia goldfish are known to be present in a large pond at Salmon Arm and in a small lake in the Lac du Bois area, Kamloops district.

Notes.—The goldfish in the pond at Salmon Arm were first noted in 1935. By 1941 they had increased tremendously in numbers so as to be conspicuous owing to the presence of many highly coloured individuals. In time the population will probably be made up mainly of fish possessing the ancestral olivaceous colour, since those with the brightest colours appear to be taken more readily by ospreys, herons, and other predators.

Since the presence of goldfish adds nothing to the economy of natural waters, these fish should not be released into any of our lakes or streams, particularly those which already contain valuable food or game fishes.

GOLDEN TENCH. *Tinca tinca* (Linnaeus).
Tinca = the Latin name for tench.

Description.—Body robust and compressed. Length possibly up to 12 inches (24 inches in Lake Union, Washington). Head short, snout rounded. Upper jaw with 2 barbels on each side. Scales small, over 100 along lateral line. Dorsal fin with short base; about 9 soft rays. Anal with about 8 soft rays.

Colour greenish-olive or golden; darker on back, lighter on belly.

Distribution.—Streams and lakes of Europe. In North America introduced into the Columbia river system, certain streams and lakes of the Puget sound drainage, and elsewhere.

In British Columbia tench are known to be present in Christina lake and Osoyoos lake (Columbia system). The species has been reported present on Vancouver island (Schultz and DeLacy, 1935; Schultz, 1936; Chapman, 1942; and Lampman, 1946), but apparently the report has not been verified.

Notes.—The tench is a sluggish carp-like fish commonly used in Great Britain in ornamental ponds. It is not highly regarded as a sport or food fish, the flesh being somewhat coarse and tasteless.

Tench were formerly supposed to have healing virtue in the touch and were looked upon as "physicians to other fishes" (Walton's "Compleat Angler").

The first-known introduction of tench into the North-west was made in 1895 in small lakes of Spokane County, Washington, and Washington County, Oregon. The fish in our Province have probably made their way from Washington up the Columbia river system.

The largest tench taken by angling in the British Isles up to 1933 weighed 7 pounds. The heaviest specimen recorded was one of 11 pounds 9¼ ounces, taken when a lake was drained in Yorkshire.

CHUB.
Peamouth.

Mylocheilus caurinus (Richardson).
Mylocheilus = grinder lip.
caurinus = of the north-west (wind).

Description.—Body elongate, little compressed. Length up to 10 inches. Head short and conical; mouth small, horizontal. Small barbel at end of maxillary. Pharyngeal teeth hooked in young, becoming blunt with age. Scales in 68 to 76 rows. Dorsal and anal fins each with 8 fully developed rays. Breeding fish with tubercles on head, operculum, back and sides nearly to lateral line.

Colour silvery with a dark back; dark band along lateral line and a second one below this from the head almost to the vent. Belly and sides reddish in spawning males.

Distribution.—Columbia, Fraser, and Skeena systems from Shoshone falls, Montana, to Babine lake, British Columbia.

In British Columbia chub are known to occur in many lakes and streams of the Columbia and Fraser systems and in Babine, Kitwanga, Morrison, and Lakelse lakes of the Skeena system. They are also present in Holden lake and Quennell (Fishhook?) lake (near Nanaimo) and in Kennedy lake and Cecilia lake (west coast), all on Vancouver island, and on Nelson island off Jervis inlet. They are also said to be present in lakes on Bowen island.

Notes.—The chub is often one of the most numerous fishes found in the shallow weedy zone of lakes. The food of young chub consists chiefly of water-fleas, copepods, midge larvæ, and other small insects. The food of larger fish is composed largely of aquatic and terrestrial insects, water-fleas, and occasionally molluscs, and rarely fishes such as small sculpins. A large individual measuring 9¾ inches in length was found to be in its sixth summer (Clemens, 1939).

Except for one Japanese species, the chub appears to be the only member of its family capable of entering the sea. One specimen in the University collection was taken along with surf smelts at Spanish banks near Point Grey in July, 1933. The ability to enter salt water may explain its presence on Vancouver island and on Nelson island, where it appears to be the only cyprinid present.

In Washington and Oregon chub are of some importance as a food fish, but they are rarely utilized in British Columbia.

LAKE CHUB.
Chub Minnow.

Couesius plumbeus greeni Jordan.
Couesius = after Dr. Elliot Coues, ornithologist.
plumbeus = lead coloured.
greeni = after Ashdown H. Green, of Victoria, B.C.

Description.—Body elongate. Length up to 4 inches. Head flattish; snout broad, projecting slightly over oblique mouth. Barbel not quite at end of maxillary. Pharyngeal teeth in main row hooked; formula 2,4–4,2. Scales in 54 to 65 rows. Dorsal and anal with 8 fully developed rays.

Colour somewhat silvery, dusky olivaceous above. A dusky band around snout and through eye to operculum. A lateral band extending from an indefinite point anterior to the dorsal fin to a blotch at the base of the caudal.

Distribution.—Of species, Adirondack region, northern New England, New Brunswick through the Great Lakes region, Manitoba, and north-west to Mackenzie river region; of subspecies (*greeni*), British Columbia and Lake Pend d'Oreille, Idaho.

In British Columbia the lake chub is known to occur in Stuart lake, in a lake near Fort St. James, in Sheridan lake, and Gardom lake (Fraser system); Babine lake (Skeena system); and Kootenay lake and Mineral lake (Columbia system).

Notes.—The British Columbia representatives of this minnow were first described as a distinct species under the name *Couesius greeni*, but it seems to be generally accepted now that the western form should be known as *C. plumbeus greeni* Jordan. Two other subspecies are described—*C. p. plumbeus* (Agassiz) from the Mac-

kenzie river region to the Great Lakes, and *C. p. dissimilis* (Girard) on the eastern slope of the Rocky mountains to across the northern part of the Great Plains.

Little is known concerning the life-history of this minnow in this Province. It seems to prefer cold-water lakes or streams.

NORTHERN MINNOW. Northern Pearl Dace.

Margariscus margarita nachtriebi (Cox).
Margariscus = a pearl.
margarita = a pearl.
nachtriebi = after Prof. H. F. Nachtrieb, State Zoologist of Minnesota.

Description.—Body elongate, little compressed. Length up to 4½ inches. Head short, snout blunt. Mouth terminal, usually with minute barbel slightly anterior to end of maxillary (often concealed in groove between maxillary and premaxillary). Pharyngeal teeth, 2,5–4,2. Scales in 60 to 72 rows. Dorsal fin with 8 rays; insertion behind ventral. Anal with 8 rays. Lateral line decurved.

Colour dusky silver, darkest on back. Upper half of operculum dusky; faint lateral stripe sometimes present. Scattered dark scales on sides.

Distribution.—From the Rocky mountains eastward through the northern states to Maine and northward to the tundra.

In British Columbia the northern minnow is known only from Stoddart creek flowing from Charlie lake, Peace River district (Peace-Mackenzie system).

Notes.—This minnow was found to be abundant in Stoddart creek, Peace River district, during the month of June, when it was observed taking flies from the surface after the manner of trout (Cowan, 1939). It is said to prefer cool lakes and creeks, particularly in boggy areas.

SILVERY-GREY MINNOW.
Dace.

Rhinichthys falcatus (Eigenmann & Eigenmann).
Rhinichthys = snout fish.
falcatus = sickle shaped.

Description.—Body elongate, almost cylindrical in section. Length possibly up to 4 inches. Head long, with snout only slightly overhanging horizontal mouth. Upper jaw protractile. Small barbel on end of maxillary. Scales in 52 to 57 rows. Dorsal with 9 rays; anal with 7. Ventral fin with 2 or 3 membranous stays uniting the inner rays with the body.

Colour silver-grey, with dark markings over back and sides.

Distribution.—Fraser and Columbia systems east of the Cascades. In British Columbia the silvery-grey minnow is known only by specimens from Shuswap and Okanagan lakes.

Notes.—Small specimens of this minnow have been taken in the shallow waters of Shuswap and Okanagan lakes in minnow seines. Nothing is known of the habits or life-history of this species in British Columbia.

LONG-NOSE DACE. *Rhinichthys cataractæ* (Cuvier & Valenciennes).

cataractæ = of the cataract, the original type being from near Niagara Falls.

Description.—Body elongate, almost cylindrical in section. Length up to 4 inches. Head long, with pointed snout overhanging horizontal mouth. Upper jaw not protractile. Barbel on end of maxillary. Scales in 62 to 68 rows. Dorsal with 8 rays; anal with 7.

Colour silvery, olivaceous to almost black on back. Dusky spots on sides; no clearly defined lateral line.

Distribution.—From coast to coast in northern North America, south along the mountains to North Carolina, northern Mexico and Oregon.

In British Columbia the long-nose dace is apparently widely distributed, being recorded from the following: Morrison lake, Babine lake (Skeena system); Chilcotin river at Hanceville, Burnaby lake (Fraser system); Okanagan lake, Garnet Valley lake, Kootenay lake (Columbia system).

Notes.—Little is known concerning the life-history of this minnow in British Columbia. It lives around shores of lakes and in swift, cool streams.

In some portions of its range outside British Columbia it occurs in sufficient numbers to be of importance as a forage fish or as a source of live bait.

SQUAWFISH. *Ptychocheilus oregonensis* (Richardson).
Ptychocheilus = folded lip.
oregonensis = of Oregon.

Description.—Body elongate, little compressed. Length in British Columbia up to 18 inches. Head long and tapered; mouth large, maxillary reaching below the eye. No barbel. Pharyngeal teeth conical, slightly curved at tip. Scales small, in 69 to 77 rows. Dorsal fin with 9 fully developed rays; anal fin with 7 to 10 fully developed rays. Lateral line complete.

Colour silvery, with greenish back; fins tinged with red or orange at spawning time.

Distribution.—Skeena, Fraser, and Columbia systems, Puget sound drainage, coastal drainage of Washington and Oregon.

In British Columbia squawfish are widely spread in the lakes and streams of the Fraser and Columbia systems and occur in Lakelse, Kitwanga, Morrison, and Babine lakes of the Skeena system.

Notes.—The squawfish is the most predaceous member of the family, actively feeding on many kinds of smaller fish and other organisms. Examinations of stomachs have shown that squawfish begin to consume fish at an early age and that a considerable proportion of their prey consists of commercially valuable fishes such as young spring and sockeye salmon. At times insects appear to be the main food item even of large individuals (Clemens and Munro, 1934). The squawfish would seem to be an undesirable species in any lake which supports sport or food fishes.

Examination of scale samples has shown that squawfish in Okanagan lake attain a length of 10 to 12 inches by their seventh

summer. One 18-inch specimen from Woods lake was apparently in its twelfth summer.

Squawfish usually ascend streams in spring and early summer for the purpose of spawning, but may also descend the outlet stream of a lake. In lakes they may be taken during the summer with an artificial fly. They are occasionally used as food in some localities.

REDBELLY DACE.

Chrosomus eos Cope.
Chrosomus = coloured body.
eos = sunrise.

Description.—Body elongate, little compressed. Length 2 to 3 inches. Head pointed, with terminal, oblique mouth. No barbel. Scales in about 85 rows. Dorsal fin with 7 or 8 rays; anal with 7 to 9 rays. Lateral line incomplete, often ending above pectoral fin.

Colour brownish-olive, with a dusky dorsal band. Two dusky lateral bands, one extending from the upper edge of the operculum to the tail, broken into spots behind; the other broader and extending from the snout through the eye to the base of the tail, where it may end in a spot. Sometimes a dark oblique line below dorsal fin from upper to lower lateral line. Sides and belly red in breeding males.

Distribution.—Peace river eastward through Manitoba to New Brunswick; southward to southern Ontario, southern Michigan, south-eastern Wisconsin, Minnesota, the Dakotas, and New Mexico.

In British Columbia the redbelly dace is known only by specimens from Charlie lake (Peace-Mackenzie system), Peace River district.

Notes.—This small minnow is characteristically found in boggy lakes, ponds, and creeks, where it forms an excellent forage fish, serving as food for larger fishes.

REDSIDE SHINER.
Red-sided Bream.

Richardsonius balteatus (Richardson).
Richardsonius = after Sir John Richardson, author of Fauna-Boreali Americana.
balteatus = girdled.

Description.—Body deep and strongly compressed. Length up to 4½ inches. Head small, with terminal, oblique mouth; no barbel. Eye large. Pharyngeal teeth without grinding surface. Scales in about 58 rows. Lateral line strongly decurved, running parallel to the contour of the ventral surface. Dorsal fin with 10 fully developed rays; insertion well behind that of ventrals. Anal fin long, with 11 to 22 (usually 16) fully developed rays.

Colour silvery, with dark olivaceous back. A dark lateral band extending from snout to base of tail, with a light streak from above the eye fading out below the dorsal fin. Light streak and side of belly crimson to old rose, side of head golden yellow in spawning males.

Distribution.—Skeena, Fraser, and Columbia systems, streams of Washington and Oregon.

In British Columbia this minnow is generally distributed in lakes and streams of the Fraser and Columbia systems. It is also known from Kitwanga lake of the Skeena system. The most northerly

record for the interior appears to be that of Tetana lake in the Driftwood valley (Stanwell-Fletcher, 1943).

Notes.—The shiner is often abundant in the weedy shallows of lakes. In Okanagan lake the food of individuals less than 2¼ inches in length consists mostly of copepods, water-fleas, and midge-fly larvae. Larger individuals were found to be subsisting on both aquatic and terrestrial insects. In Okanagan lake this minnow does not appear to be of much benefit to trout as a food fish, since the distribution of the two species is such that seldom are they brought together (Clemens, 1939).

In some lakes in the vicinity of Fernie shiners are said to have appeared in recent years, being introduced by anglers releasing live bait.

THE CATFISHES. FAMILY AMEIURIDÆ.

A catfish is easily recognized by its scaleless body, adipose fin, spine in dorsal and pectoral fin, and elongated barbels around the mouth. Most members of this family are native to North America east of the Rockies. The two species found in British Columbia have been introduced indirectly from eastern North America.

KEY TO THE SPECIES.

1 (2) Pectoral spine with strong barbs on posterior edge; fin membranes seldom jet-black; lower sides of body often more or less mottled; no light bar at base of caudal fin; anal rays, 21 to 24.

Brown catfish—*Ameiurus nebulosus.*

2 (1) Pectoral spine without strong barbs; fin membranes jet-black; lower sides of body not mottled; white bar at base of caudal fin in adults; anal rays, 17 to 20.

Northern black catfish—*Ameiurus melas melas.*

BROWN CATFISH.
Brown Bullhead.

Ameiurus nebulosus (LeSueur).
Ameiurus = not curtailed, referring to unnotched tail fin.
nebulosus = clouded.

Description.—Body moderately long, heaviest toward the head. Total length up to 12 or more inches. Head large and wide; mouth large, with 8 barbels. Dorsal fin with a sharp spine and 6 rays. Ventral and pectoral fins each with a spine; pectoral spines with strong barbs on posterior edge. Anal fin with 21 to 24 rays. Adipose fin present.

Colour dark yellowish-brown, somewhat mottled or clouded. No light bar at base of caudal fin. Membranes of fins seldom jet-black.

Distribution.—Widely distributed in central and eastern States and Canada. Introduced on the Pacific coast.

In British Columbia the brown catfish is found in the lower Fraser river system and in the following lakes on Vancouver island: Beaver, Elk, Langford, Prospect, Thetis, Swan, Glen, Lost, Goodacre (all near Victoria), Shawnigan (28 miles north of Victoria), Somenos (near Duncan), and Young (near Sooke).

Notes.—The date of introduction of catfish into the North-west is apparently unrecorded; those now found on Vancouver island are said to have been introduced in 1906 by the late Mr. H. E. Levy, who imported live specimens from Portland, Oregon, for the purpose of displaying them in a tank in a restaurant which he operated in

Victoria at that time. According to his son, Mr. A. Levy, of Victoria, a few of these catfish were given to a man by the name of Clark, who planted them in Beaver lake, a few miles north of Victoria, by throwing them from the window of the train which in those days operated between Victoria and Sidney. About the same time others were planted in Langford lake, about 10 miles north-west of Victoria. The other bodies of water on Vancouver island in which catfish are now found probably were stocked with fish taken from either of these two sources.

Spawning takes place in the late spring, when both parents stand guard over the eggs which are often laid in holes excavated in muddy banks. The free-swimming dark-coloured young are herded through the shallows by an attentive parent until they can look after themselves. The food consists largely of aquatic insects.

In general, catfish are not in high favour with anglers. This is particularly so where they occur in lakes which also support trout, because at certain seasons the less desirable catfish take the bait and occupy the time or try the patience of the sportsman when he is intent upon catching the more desirable trout. In addition, anglers believe that catfish prey upon the eggs and fry of game fish, but accurate information concerning the effect of catfish upon trout is not available. The common catfish, when taken from clear, cool water, is an excellent pan fish.

NORTHERN BLACK CATFISH. *Ameiurus melas melas* (Rafinesque).
Black Bullhead. *melas* = black.

Description.—Body short and stout; heaviest toward the head, and stouter than in the brown catfish. Total length possibly up to 10 inches. Head large and wide; mouth large with 8 barbels. Dorsal fin with a sharp spine and 6 rays. Ventral and pectoral fins each with a spine. Pectoral fins shorter than in brown catfish, and spine without barbs. Anal fin with 17 to 20 rays. Adipose fin present.

Colour dark brown to almost black; under-parts back to anal fin, greenish to yellowish (at times golden yellow). A light bar at base of caudal fin in adults. Membranes of fins dusky or jet-black.

Distribution.—North Dakota east through the Great Lakes drainage south and westward to Pennsylvania, Tennessee, Kansas, Wyoming, and Colorado.

In British Columbia the black catfish is known only by specimens taken in Osoyoos lake (Carl, 1945).

Notes.—The northern black catfish has been reported present in the Columbia river system of Washington State as early as 1896. However, in view of the difficulty experienced in identifying members of this genus, it is possible that these early records were based on *nebulosus* rather than *melas*. Although there appear to be no more recent authoritative records of this species in the State of Washington, those now occurring in British Columbia probably arrived in this

Province by way of the Okanagan river, which is a tributary of the Columbia.

The black catfish is a typical fish of ponds, sloughs, and backwaters of lakes and rivers, where the water is shallow and often silty.

The breeding and other habits are similar to those of the brown catfish.

THE PIKES. FAMILY ESOCIDÆ.

The pikes are characterized by a long slender body, with the dorsal fin placed far back near the tail. The long jaws are armed with sharp canine teeth; the fins have no spines.

The family includes the pikes, the true pickerels, and the maskinonge (muskellunge). The northern pike is the only representative known to occur in British Columbia.

NORTHERN PIKE.
Jackfish.

Esox lucius Linnaeus.
Esox = a kind of pike.
lucius = a Latin name for the pike.

Description.—Body elongate, somewhat compressed toward the tail. Total length up to 4 feet and weight up to 20 pounds (probably not so large in British Columbia). Head long; snout long and depressed. Mouth large, lower jaw longer than upper; teeth on both jaws, roof of mouth, and tongue. Dorsal fin set well back toward tail.

Colour bluish- to greenish-grey, with light irregular spots on sides in adults, arranged somewhat in rows. Under-parts whitish or yellowish. Oblong dark spots on dorsal, anal, and caudal fins. Young with light bars which later break up to form the spots of the adult.

Distribution.—Northern portions of the Northern Hemisphere; in North America from Alaska to Labrador and south to northern New England, the Hudson river drainage of eastern New York, the northern portion of the Ohio valley, the Great Lakes district, Missouri, and eastern Nebraska.

In British Columbia pike are known to occur in Dease lake and river, Liard river, Tupper creek, Swan lake, and Peace river (Liard and Peace-Mackenzie system); Teslin lake (Yukon system).

Notes.—The pike is a voracious feeder, consuming large numbers of other fishes, insects, and other animal food. It ranks high as a game fish, since it puts up a good fight when hooked. Its flesh is excellent as food, especially when baked, though somewhat strong at times by reason of large secretions of mucus in the skin, a flavour which may be avoided by skinning the fish.

Pike spawn in early spring as soon as the ice breaks up. At this time they may enter streams or move into flooded margins of lakes to deposit their eggs. In the southern parts of its range the young hatch in about two weeks and grow rapidly, reaching a length of 8 to 12 inches by the end of the first summer.

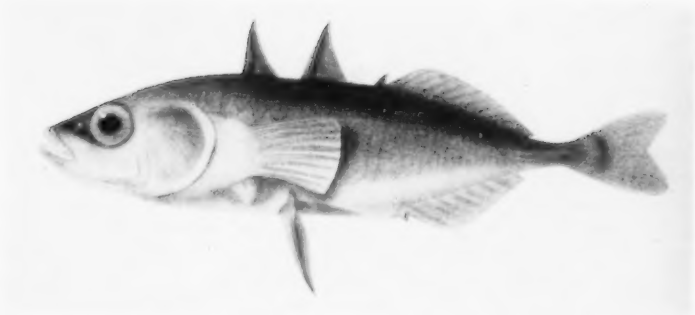
THE STICKLEBACKS. FAMILY GASTEROSTEIDÆ.

Sticklebacks are small fishes with compressed bodies protected by a few bony plates or shields in place of scales. A number of sharp, erectile spines representing the spinous dorsal fin precede a rayed dorsal fin; a free spine precedes the anal fin and each ventral fin. The mouth is small, but equipped with tiny teeth; the lower jaw projects beyond the upper.

KEY TO THE SPECIES.

1 (2) Spines before rayed dorsal fin, 3.
Three-spined stickleback—*Gasterosteus aculeatus.*

2 (1) Spines before rayed dorsal fin, 5 to 7.
Brook stickleback—*Eucalia inconstans.*



THREE-SPINED STICKLEBACK. *Gasterosteus aculeatus* Linnaeus.
Gasterosteus = belly bone, referring to the bony ventral plate.
aculeatus = spined.

Description.—Body somewhat spindle-shaped, tapering to a slender caudal peduncle. Total length up to 3 inches (in fresh water). Head short, with small oblique mouth and large eye. Three erectile dorsal spines; the first two long, the third short. Ventral spines erectile, long, and sharp; anal spine short. Plates on side of body above pectoral fin few in number or wanting. Ventral plate broad and long. Lateral line complete.

Colour greenish- or greyish-olive; silvery on lower sides and belly. Darker mottlings occasionally forming indistinct bars on back. Pinkish throat and belly in breeding females; carmine throat and belly, blue eye, and greenish fins in breeding males.

Distribution.—Northern Hemisphere in both salt and fresh water. In North America from Lower California to Alaska, the Hudson bay region, Chesapeake bay and Lake Ontario basin. In British Columbia the stickleback is apparently present in most rivers and streams of the coastal area.

Notes.—Sticklebacks vary greatly in size, in number of shields, and in extent of the ventral plate according to the type of environment occupied by the fish. Fresh-water forms are usually smaller and less heavily mailed than marine forms.

Their food consists largely of small plankton organisms such as water-fleas and copepods, and also aquatic insect larvæ, small crustaceans, and other animal forms usually found on the bottom. A considerable amount of plant material (algæ) is also taken.

Breeding takes place throughout the summer months (April to September, inclusive, in the Cowichan river), the male constructing a saucer-shaped nest on the bottom in shallow water. The nest materials include plant debris, bits of stick, etc., held together by a mucilaginous secretion apparently from the kidneys of the male. Several females contribute eggs, as many as 600 (product of possibly six or seven females) being occasionally found in one nest.

Sticklebacks form an important article of diet for trout and other game fishes in some localities. They are also extensively eaten by the American merganser and possibly by other fish-eating birds.

BROOK STICKLEBACK.

Eucalia inconstans (Kirtland).
Eucalia = well, nest; builds nests as do other members of the family.
inconstans = variable.

Description.—Body somewhat spindle-shaped, tapering to a slender caudal peduncle. Total length up to 2½ inches. Head short, with small oblique mouth and large eye. Five to seven short sharp spines on back and connected by a cartilaginous ridge. Ventral spines short and sharp; anal spine short. No plates or scales. Lateral line complete.

Colour dark olivaceous, mottled and spotted on the sides. Breeding males black.

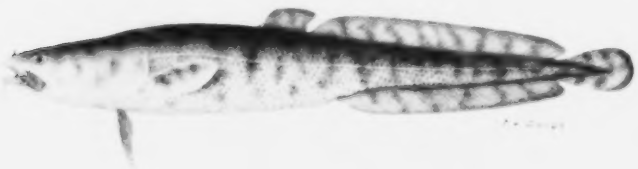
Distribution.—In Canada from northern British Columbia east to the Maritimes; in the United States from Montana to New York and northern Maine; south to Pennsylvania, Ohio, Indiana, Illinois, and Kansas.

In British Columbia brook sticklebacks are known only from Charlie lake and Stoddart creek (Peace-Mackenzie system).

Notes.—The brook stickleback is often abundant in spring-fed brooks, boggy lakes, and trout streams. It feeds upon small insects, crustacea, and algæ. It breeds in early summer (June in Stoddart creek), the males building a nest and guarding the eggs and young assiduously.

THE CODFISHES. FAMILY GADIDÆ.

In codfishes the body is long and tapered, with an elongated dorsal fin usually in three parts, but in two parts in the fresh-water species and in some of the marine forms. No spines are present. A characteristic feature is the presence of a barbel beneath the lower jaw. Most species are marine; one species is found in fresh water and is circumpolar in distribution. At least two races are represented in British Columbia.



LING. *Lota lota* (Linnaeus).
Burbot. *Lota* = an ancient name used by Rondelet.

Description.—Body long, compressed behind. Total length up to 40 or more inches. Head long, depressed; mouth large. Single barbel below tip of lower jaw; a small barbel at each anterior nostril. Dorsal fins, 2—the first short with about 13 rays; the second long with about 76 rays. Caudal fin rounded. Anal fin long with

about 68 rays. Ventral fins in front of pectorals and ending in a filament. Body covered with small imbedded scales. Lateral line complete.

Colour dark olive, thickly mottled with darkish markings on back and sides. Yellowish or dusky below. Dorsal, caudal, and anal fins mottled and with a dark border.

Distribution.—Europe, Siberia, and northern North America.

Two subspecies are recognized in North America by Hubbs and Schultz (1941): *Lota lota leptura* Hubbs and Schultz from northern British Columbia, Alaska, and Siberia; *Lota lota maculosa* (LeSueur) in lakes of the Columbia system and in eastern North America. Those in intermediate areas, for example those of the Fraser system, are apparently intergrades between these two subspecies.

In British Columbia ling are known to occur in Lake Bennett, Tagish lake, Atlin lake, Teslin lake (Yukon system); Swan lake, Meadow creek, Tupper creek (Peace-Mackenzie system); Babine, Bear, Morrison, and other lakes (Skeena system); most of the large lakes in the Fraser system; most of the large lakes of the Okanagan, Kootenay, and Columbia system.

Notes.—Ling are found in the colder portions of lakes, chiefly in deep water during the summer, and in large streams or rivers. Their main food consists of fish, particularly kokanee and ciscoes, augmented with aquatic insect larvæ and other organisms; at times they may be destructive of food and game fishes and their eggs.

Spawning apparently takes place in early spring, often before the ice goes out; the eggs are laid either in tributary streams or in suitable places in lakes.

Ling may be taken by set-lines or nets in deep water during the summer or by spearing through the ice in winter. They are used as food by natives and whites in some areas, but are not highly esteemed by most. The liver contains oil said to be comparable to that of the salt-water cod in vitamin potency. In the United States large quantities of ling are sold for the manufacture of pet food.

The ling is also known as "loche" and "lush" (Alaska), "maria" (Saskatchewan), and "lawyer" (eastern States).

THE PERCHES. FAMILY PERCIDÆ.

In the members of this family the body is elongated, the operculum ends in a flat spine, the dorsal fins are completely separate, the first fin having about 13 spines and the second fin being provided with soft rays. The anal fin has one or two spines, and teeth are present on the jaws and usually on the vomer and palatines.

Two species, one native and one introduced, are known to be present in British Columbia.

KEY TO THE SPECIES.

1 (2) No canine teeth; body deep, compressed; second dorsal fin with 13 to 15 rays; pelvic fins close together; dark cross-bars on side of body.

Yellow perch—*Perca flavescens.*

2 (1) Canine teeth strong; body subterete; second dorsal fin with 19 to 21 rays; pelvic fins widely separated; no dark cross-bars on side of body.

Pike-perch—*Stizostedion vitreum.*

YELLOW PERCH. *Perca flavescens* (Mitchill).
Perca = an ancient name meaning dusky.
flavescens = yellowish.

Description.—Body oblong, somewhat compressed. Total length up to 12 inches. Mouth moderate; many small teeth in bands, but no canines. Single spine on gill cover. Dorsal fins separated, the first with 13 to 15 spines, the second with 13 to 15 soft rays. Scales strongly ctenoid, in 74 to 88 rows.

Colour yellowish, with 6 or 8 broad dark cross-bars from the back to below the middle of the sides. Upper fins dusky. Lower fins reddish or orange in breeding males.

Distribution.—Hudson bay drainage south to Kansas and northern portion of Missouri, Illinois, Indiana, Ohio, and to western Pennsylvania; in coastwise streams from Nova Scotia to South Carolina.

In British Columbia perch are known to occur in Osoyoos lake and Vaseaux lake (Okanagan-Columbia system). They are also reported to be present in Lush lake, adjacent to the Keremeos highway, and in Shannon lake, near Westbank, Okanagan lake. They probably originated from Washington, where the species was first introduced in 1890 and where it is now widely distributed.

Notes.—Perch prefer lakes, ponds, and large sluggish streams; they are seldom found where there is a strong current. They some-

times occur in large numbers, usually swimming in loose schools. Their food consists largely of animal organisms such as small fish, insects, crustaceans, etc. Though often of small size, perch are widely sought as a sport and pan fish. In Osoyoos lake perch fishing is of some importance, some anglers preferring to fish for them rather than for trout, which are less numerous and often more difficult to catch.

Perch spawn in the early spring, laying large numbers of eggs in long ribbon-like bands over sticks and water-weeds on sandy bottoms.

PIKE-PERCH.
Wall-eyed Pike.
Doré.

Stizostedion vitreum (Mitchill).
Stizostedion = pungent throat.
vitreum = glassy, from the large eye.

Description.—Body elongate, almost cylindrical in section. Length up to 3 feet (in southern portion of its range). Head long and conical. Mouth large. Teeth in bands; sharp canines on jaws and roof of mouth. One or more spines on gill cover. Dorsal fins well separated; the first with 12 to 15 spines, the second with 19 to 21 soft rays. Scales strongly ctenoid in 110 to 132 rows.

Colour dark olive mottled with brassy specks; vermiculations on side of head; lower jaw flesh-coloured; large black spot at base of last dorsal spine.

Distribution.—From the Mackenzie river system eastward to Labrador; southward to North Carolina, Alabama, northern Arkansas, and Nebraska.

In British Columbia pike-perch are known to be present in the Peace river; the species is also reported to be present in Beatton and Kiskatinaw rivers, Muskwa (Sikanni) river, and in Klua lakes (Peace-Mackenzie system).

Notes.—The pike-perch is a fish of clear, cold lakes and rivers, thriving best where it has a wide range. It is an active swimmer, capable of travelling considerable distances. Its food consists largely of small fish, but other organisms are also taken.

Spawning takes place in tributary streams or on the gravelly bottom of lakes soon after the ice goes out.

Pike-perch are apparently not taken in numbers in this Province, but in other parts of their range they rank high as a sport and food fish. In Saskatchewan, where it is known as the pickerel, it ranks third in poundage and value in the commercial fishery.

THE BASSES AND SUNFISHES.
Family CENTRARCHIDÆ.

Fishes in this family are characterized by deep, compressed bodies, with the dorsal fin incompletely divided into two parts. The anterior portion is supported by 3 to 10 spines; the posterior portion is provided with soft rays only. The ventral fins are thoracic in position and are usually provided with 1 spine and 5 rays; the anal has 3 to 9 spines.

The family is represented in British Columbia by four introduced species.

Key to the Species.

1 (4) Anal spines small, longest less than half length of longest ray; last spine bound to first ray.

2 (3) Maxillary extending to point between middle of pupil and hind margin of eye; dorsal fin shallowly emarginate between spinous and rayed portions.

Smallmouth bass—*Micropterus dolomieu.*

3 (2) Maxillary extending beyond hind margin of eye; dorsal fin deeply emarginate between spinous and rayed portions.

Largemouth bass—*Micropterus salmoides.*

4 (1) Anal spines large, longest more than half length of longest ray; last spine separated from first ray by membrane.

5 (6) Anal spines 3, rarely 4; anal fin less than half as long as dorsal; gill rakers short.

Pumpkinseed—*Lepomis gibbosus*.

6 (5) Anal spines, 5 to 7; anal fin about as long as dorsal; gill rakers long and slender.

Black Crappie—*Pomoxis nigro-maculatus*.

SMALLMOUTH BASS.
Smallmouth Black Bass.

Micropterus dolomieu Lacépède.
Micropterus = small fin; the dorsal fin of the type specimen had been mutilated and a portion was mistaken for a second small fin.
dolomieu = after M. Dolomieu, a mineralogist of Paris.

Description.—Body oblong and compressed. Total length up to about 20 inches. Mouth large, not reaching hind margin of eye (mouth closed). Dorsal fin notched but not divided; 10 spines followed by 13 to 15 soft rays. Scales weakly ctenoid in 72 to 85 rows.

Colour dark green to pale olive-brown flecked with gold; whitish below. Darker mottlings or indistinct bands on sides; three dark bands radiating from eye across side of head. Eye reddish. In the young the tail fin has a yellowish base, black centre, and a white tip.

Distribution.—Northern Minnesota to Quebec and south to the Tennessee system of Alabama and to eastern Oklahoma. Extensively introduced elsewhere.

In British Columbia smallmouth bass are known to occur in the following: Christina lake, Boldue lake (Columbia system); Florence, Langford, Beaver, Elk, Prospect, Durrant, Lost, and Glen lakes (all in vicinity of Victoria); Spider lake (north of Nanaimo); St. Mary lake (Saltspring island). The species is also said to be present in Moyie lake, south of Cranbrook.

Notes.—The smallmouth bass now found in this Province were introduced as fry or fingerlings in the fall of 1901 on both the mainland (Christina lake) and Vancouver island (Langford and Florence lakes). In 1920 a few fish were removed from Langford lake and released in St. Mary lake, Saltspring island; three years later, specimens were transferred from Florence lake to Spider lake. The other lakes now containing this species were probably subsequently stocked from these sources.

Smallmouth bass prefer lakes of moderate size, clear water, and gravel bottoms, and occasionally cold, swift-flowing streams. Major food items include small fishes, crayfish, insect larvæ, and other animal food. They spawn in early summer in nests constructed on gravel and sand bottom, and the eggs and young are tended by the male. They are highly regarded as game fish in eastern North America; in British Columbia they are not as popular as the native trouts.

LARGEMOUTH BASS. *Micropterus salmoides* (Lacépède).
Largemouth Black Bass. *salmoides* = trout-like.

Description.—Body oblong and compressed. Total length 18 inches or more and weight up to 20 pounds or more. Mouth large, extending beyond hind margin of eye (mouth closed). Dorsal fin almost divided; 10 spines followed by 12 or 13 soft rays. Scales weakly ctenoid, in 65 to 70 rows.

Colour more or less dark green; greenish-silver on sides and pale below. Dark bands radiating from eye and faint dark band on sides of body. Lateral band distinct in young stages.

Distribution.—Manitoba east to Quebec, through Great Lakes region and Mississippi valley to north-eastern Mexico and Florida; north along the coastal plain to North Carolina. Widely introduced elsewhere.

In British Columbia largemouth bass are found in Vaseaux, Osoyoos, and Kootenay lakes (Columbia system). They are also said to be present in Mirror lake, 2 miles south of Kaslo, and in a private lake adjacent to the road from Crawford bay to Kootenay bay.

Notes.—According to Dymond (1936) largemouth bass are said to have escaped from private ponds into the Kootenay river at Bonners Ferry, Idaho, in 1916. The species was taken near Kootenay Landing for the first time in 1921, when Mr. A. Bush, of Nelson,

caught a 5½-pound specimen at Sirdar. Those in the Okanagan valley probably also gained access to the Province from the south.

Largemouth bass are typical of weedy, mud-bottomed lakes, sloughs, and other sluggish waters. Their principal food comprises fishes, frogs, crayfish, and other animal items. Like the smallmouth bass, this species breeds in spring and early summer, constructing shallow nests on gravel bottoms. The male stands guard over the eggs and young fish for some time after hatching.

The largemouth bass is one of the most popular sport fishes in the central States, but it is only of local interest in British Columbia.

PUMPKINSEED.
Sunfish.

Lepomis gibbosus (Linnaeus).
Lepomis = scaled gill cover.
gibbosus = formed like the full moon.

Description.—Body ovate and compressed. Total length up to 8 inches. Mouth small, oblique, scarcely reaching front of eye. Dorsal fin continuous, with 10 spines and 10 to 12 soft rays. Anal spines 3, rarely 4. Scales large, in 40 to 47 rows.

Colour greenish- or bluish-olive above, sides spotted with orange. Cheeks orange with wavy blue streaks and a bright scarlet spot on

lower edge of gill-cover lobe. Belly yellowish-orange. Upper fins bluish with orange spots; lower fins orange.

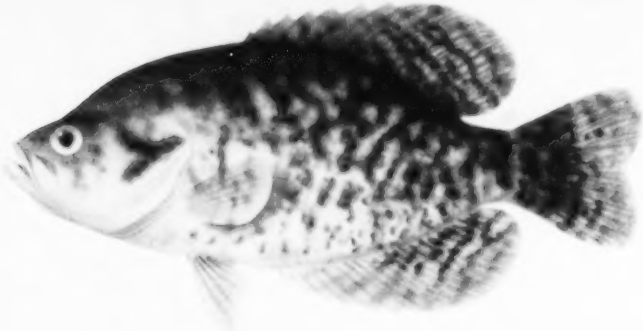
Distribution.—From the Dakotas eastward through the Great Lakes region to the Maritime Provinces and Maine; southward to northern Georgia and possibly Florida and to western Pennsylvania, Ohio and Missouri in the Mississippi system.

In British Columbia pumpkinseeds are present in Christina lake, Kootenay lake (near Creston), Boldue lake (near Ehold), and Osoyoos lake (Columbia system). They are also present on Vancouver island in the following lakes: Beaver, Elk, Prospect, Langford, and Glen (near Victoria), and Glintz and Young (near Sooke). They occur also in ponds in Beacon Hill park and in the brick-yard in Victoria.

Notes.—Pumpkinseeds prefer weedy lakes and ponds with clear, cool to moderately warm water. They feed mainly on water-snails, insects, small crustaceans, and other animal food; occasionally they are destructive to eggs and fry of other fishes. Pumpkinseeds spawn in summer, constructing a nest in shallow water. The brightly coloured male stands guard over the eggs and newly hatched young, chasing away all intruders.

Although it is an excellent pan fish, the pumpkinseed cannot be classed as a game fish of importance, except possibly in the estimation of youthful anglers.

The origin of the pumpkinseeds now found in this Province does not appear to be known. Since they are found in most of the lakes into which smallmouth bass were originally introduced, it is possible that fry were accidentally planted along with the bass.



BLACK CRAPPIE.
Calico Bass.

Pomoxis nigro-maculatus (LeSueur).
Pomoxis = sharp gill cover.
nigro-maculatus = dark-spotted.

Description.—Body ovate and much compressed. Total length up to 12 inches. Mouth large, oblique, reaching posterior edge of pupil. Dorsal fin continuous, with 7 or 8 spines and 14 soft rays. Anal spines, 5 to 7. Scales large, weakly ctenoid, in 40 to 45 rows.

Colour silvery-olive mottled with olive-green, the mottlings on the dorsal, anal, and caudal fins arranged somewhat in rows; a dusky irregular spot on gill cover. Juveniles with dusky bars on sides.

Distribution.—Southern Manitoba east through the Great Lakes region to Quebec and southward through the Mississippi system to Texas and northern Florida; north on the Atlantic coast to North Carolina. Widely introduced in Washington and Oregon.

In British Columbia the black crappie is present in Hatzic lake and slough, Burnaby lake, Sumas river, Dewdney, Nicomen and Sturgeon sloughs, and possibly in other bodies of water connected with the lower Fraser system.

Notes.—The preferred habitat of the black crappie is clear, weedy lakes and the larger streams, where it sometimes occurs in considerable numbers. Small fishes, crustaceans, and insects are the chief food

items. Crappies spawn in early summer, building nests much like those of the other members of the family.

In its natural range the crappie ranks high as a sport and food fish, enormous numbers being taken each year by anglers.

The origin of the black crappies now found in British Columbia appears to be unknown.

THE SCULPINS. FAMILY COTTIDÆ.

The members of this large family are mostly marine, but a few species venture into fresh water or live their entire life in lakes and streams. They are bottom-dwelling fishes of cool waters. The head is large and the operculum ends in one or more spines. The body is naked or provided with a few scales, prickles, or bony plates. The pectoral fins are large and fan-like.

KEY TO THE SPECIES.

1 (4) Palatine bones, each with a band of well-developed teeth.

2 (3) Dorsal rays, 19 to 23; anal rays, 16 to 19.
Prickly sculpin—*Cottus asper*.

3 (2) Dorsal rays, 16 or 17; anal rays, 12 to 14.
Torrent sculpin—*Cottus rhotheus*.

4 (1) Palatine bones without teeth, or nearly so.

5 (6) Preopercle with a spine at its angle, and 2 spines below; anal rays, 12.
Mottled sculpin—*Cottus cognatus*.

6 (5) Preopercle with a spine at its angle and no small spines below; anal rays, 13 or more.

7 (8) Posterior nostril tubular; lateral line complete.
Aleutian sculpin—*Cottus aleuticus*.

8 (7) Posterior nostril not tubular; lateral line incomplete.
Snow-water sculpin—*Cottus philonips*.

PRICKLY SCULPIN.

Cottus asper Richardson.
Cottus = an old European name.
asper = rough.

Description.—Body spindle-shaped. Total length up to 12 inches (7 inches in British Columbia). Head wedge-shaped, with large mouth. Palatine teeth well developed. Preopercular spine long and sharp, one smaller spine below it. Dorsal fin almost divided, with 8 or 9 spines and 19 to 23 soft rays. Anal rays, 16 to 19. No scales. Prickles may be in band along lateral line, in patch behind pectoral fin, or over most of body except ventral surface; commonly absent from caudal peduncle. Lateral line usually complete; sometimes lacking on caudal peduncle.

Colour greyish-olive, with dark spots and saddle-shaped mottlings; under-parts whitish, sometimes with very fine specklings of black. Dark wavy cross-bars on dorsal, pectoral, and caudal fins; a dark spot on membranes between last few spines of spinous dorsal.

Distribution.—Coastal streams and tributary lakes from Alaska south to California.

In British Columbia the prickly sculpin has been recorded from Nass river; Lakelse, Stephens, Swan, and Kitwanga lakes (Skeena system); Middle river, Shuswap lake, Griffin lake, Blue lake, Kamloops, Summit lake, Seton lake, Hanceville, Harrison lake, Mission, Cultus lake, and Fraser river (Fraser system); Okanagan lake, Six-mile creek (Vernon), Osoyoos lake, Christina lake (Columbia system); Horne lake, Spider lake, Millstream (Nanaimo), Cowichan lake and river, Quamichan lake, Shawnigan lake (Vancouver island); McClinton creek (Queen Charlotte islands).

Notes.—The prickly sculpin is able to live in both fresh and brackish water, which probably accounts for its wide distribution in coastal streams of this Province. It feeds mainly on small fishes (including its own species), fish-eggs, insect larvæ, molluscs, crustacea, and other animal forms. At times this sculpin may be somewhat destructive of the eggs and fry of food and game fishes. At the same time it is occasionally extensively eaten by trout. It is, in turn, one of the chief items in the diet of mergansers and possibly other birds of similar feeding habits.

The species spawns in spring and early summer, the eggs being laid in a mass protected by stones or other cover. Fry ranging in length from one-quarter to one-half inch have been taken in plankton hauls at night in the Cowichan river during June.

TORRENT SCULPIN.

Cottus rhotheus (Rosa Smith).
rhotheus = rushing of the torrent, referring to its habitat.

Description.—Body spindle-shaped, widest at shoulders. Total length up to 4 inches. Head wedge-shaped, with large mouth. Palatine teeth well developed. Preopercular spine sharp with 2 smaller spines below it. Dorsal fins almost divided; 7 or 8 spines in first portion and 16 or 17 rays in the second. Anal rays, 12 to 14. No scales. Coarse prickles on back and sides. Lateral line occasionally incomplete on caudal peduncle.

Colour dark grey with dusky spots and mottlings; underparts whitish, with small dark spots in large individuals. Dorsal, pectoral, and caudal fins with dusky mottlings forming cross-bars.

Distribution.—Kootenay and Columbia rivers; Puget sound drainage; south to Nehalem river, Oregon.

In British Columbia the species is known at present only from the Kootenay river (Slocan pool) and from Blue and other lakes near Princeton.

Notes.—This small sculpin is widely distributed in the State of Washington, particularly in rivers and streams where it has a slight commercial value as bait.

MOTTLED SCULPIN.
Slimy Muddler.

Cottus cognatus Richardson.
cognatus = related (to the European species).

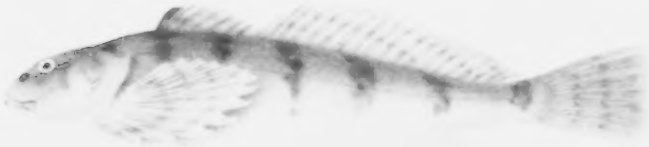
Description.—Body long and rather stout. Total length up to 4 inches. Head short, with large mouth. Palatine teeth absent, or nearly so. Preopercular spine directed obliquely upward; 2 small spines below. Dorsal fin almost divided; 7 to 8 spines in first dorsal and 15 to 17 rays in the second. Anal rays, 12. No scales. Prickles in patch behind pectoral fins. Lateral line short, ending below first few rays of second dorsal or before.

Colour dark brown or greyish with dark mottlings, lighter below. Dorsal, pectoral, and caudal fins with dark mottlings arranged in cross-bars.

Distribution.—From Alaska and British Columbia eastward to Labrador; south on the Atlantic slope to West Virginia; Great Lakes region; northern Minnesota and Iowa.

In British Columbia the mottled sculpin has been reported from Lake Bennett and Teslin lake in the north and Kootenay lake and Christina lake in the south.

Notes.—The mottled sculpin is characteristically found on the bottom in cold streams and lakes. In Teslin lake it feeds chiefly upon aquatic insects and in turn is eaten by small Great Lakes char, pike, and ling.



ALEUTIAN SCULPIN.

Cottus aleuticus Gilbert.
aleuticus = of the Aleutians.

Description.—Body long and slender. Total length up to 3 inches. Head small, with small mouth. Palatine teeth absent. Preopercular spine, long, sharp, and directed obliquely upward. Posterior nostril tubular. Dorsal fins joined at base; the first with 9 or 10 spines, the second with 16 to 20 soft rays. Anal fin with 13 or 14 rays. No scales. Line of prickles occasionally below lateral line. Lateral line complete, with an abrupt dip toward its end.

Colour light brown, mottled or spotted above. Dark mottlings on back and sides often in 6 ventral cross-bars or saddles, 2 below spinous dorsal, 3 below soft dorsal, and 1 on caudal peduncle. Rays of dorsals, pectoral, and caudal fins crossed with series of dark blotches.

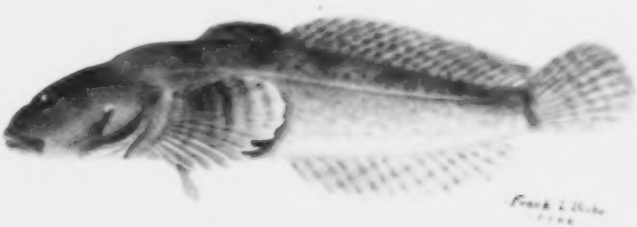
Distribution.—Coastal streams from California to Unalaska.

In British Columbia the Aleutian sculpin is known to occur in Cultus lake (Fraser system), a stream at Departure bay, Nanaimo, Vancouver island, and in McClinton creek, Queen Charlotte islands.

The species will probably be found to occur in many other coastal streams of the Province.

Notes.—Small specimens of this sculpin were collected on May 30, 1942, in Smith creek, flowing into Cultus lake. Here they were associated with spawning brook lampreys (and were probably feeding upon the eggs of this species). This sculpin is eaten to some extent by game fishes; a Dolly Varden taken from Cultus lake was found to contain several individuals.

Like some others of the group, the Aleutian sculpin occasionally resorts to brackish and salt water.



SNOW-WATER SCULPIN. *Cottus philonips* Eigenmann & Eigenmann.
philonips = lover of snow-water.

Description.—Body slender. Total length about 3 inches. Head short and broad. Mouth large, reaching middle of eye. Palatine teeth absent. Preopercular spine small. Posterior nostril not tubular. Dorsal fins divided; 9 spines in first fin, 17 rays in second. Anal with 13 rays. No scales or prickles. Lateral line incomplete.

Colour light grey, with many spots forming reticulations on top of head and sides of body; under-parts white. Dorsal fin dusky with narrow white edge; pectorals and caudal fins with wavy dark bars.

Distribution.—Known only from the Kicking Horse river, at Field, B.C. (Columbia system).

Notes.—The status of *C. philonips* is not entirely clear; it resembles very closely another and better-known species, the smooth sculpin (*C. beldingii*), which is found in the Columbia system in Washington and south to Lake Lahontan. Further study may show

that *C. philonips* is indeed identical with *C. beldingii* or with a related species, such as *C. tubulatus* (Hubbs and Schultz, 1932).

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POSSIBLE ADDITIONAL SPECIES.

The following fishes have been reported as occurring in this Province or are likely to be found within its borders because they are present in adjacent areas. They are listed here so that attention may be called to their possible presence in British Columbia waters:—

TOP MINNOW. *Gambusia* sp.?

Introduced into ponds of the Kelowna area about 1928 for mosquito-control; it is not known if any still survive.

WHITE CRAPPIE. *Pomoxis annularis* Rafinesque.

Widespread in the State of Washington (Chapman, 1942).

GOLDEYE. *Amphiodon alosoides* Rafinesque.

Reported from Peace river at Peace Point, Alberta (Kendall, 1924).

LAURETTA HERRING. *Leucichthys autumnalis* (Pallas).

Anadromous in rivers of north-western America and north-eastern Asia (Dymond, 1947).

SMALL-SCALED SUCKER. *Catostomus syncheilus* Hubbs and Schultz.

Reported as probable occurrence in the Columbia river at Golden, B.C. (Hubbs and Schultz, 1932*a*).

BLACK-SIDED DACE. *Rhinichthys osculus nubilus* (Girard) [=*Apocope nubila* (Girard)].

Reported from Yellowhead lake, Mount Robson national park, and also from Jasper park (Bajkov, 1927).

BIGMOUTH SCULPIN. *Cottus gulosus* (Girard).

Common in coastal streams from central California to Alaska. No definite records from British Columbia.

ROCKY MOUNTAIN SCULPIN. *Cottus punctulatus* (Gill).

Reported from both slopes of the Rockies, Athabasca river, and Maligne river (Bajkov, 1927).

GLOSSARY.

Adipose fin—the small, fleshy fin on the back between the dorsal and caudal fin in some groups of fishes.

Anadromous—ascending rivers from the sea for the purpose of spawning.

Anal fin—the fin on the ventral median line of the body behind the anus.

Anterior—in front of, or toward the head end.

Antrorse—turned forward.

Barbel—a small finger-like process usually near the mouth and provided with the sense of touch or smell.

Body—that portion of a fish between the head and the base of the caudal fin.

Branchiostegal membrane—the membrane enclosing the gill chamber ventrally.

Branchiostegals—the bony rays which support the branchiostegal membrane.

Cæcum (pl. *cæca*)—a blind sac—e.g., the pyloric cæca—connected with the anterior portion of the intestine.

Canine tooth—pointed and conical, similar to that of a dog.

Caudal fin—the tail fin.

Caudal peduncle—that portion of the fish's trunk between the anal fin and the origin of the tail fin; the slender portion immediately in front of the tail fin.

Cilium (pl. *cilia*)—a hair-like outgrowth which beats in unison with others to produce a current of water or for propulsion.

Circulus (pl. *circuli*)—one of a series of concentric ridges on a fish scale.

Ctenoid (scales)—with a comb-like margin.

Cycloid (scales)—scales whose free border presents an even curve.

Dorsal fin—the main fin on the mid-line of the back.

Fry—the young stage of fishes, particularly after the yolk sac has been absorbed.

Ganoid (scales)—plate-like, consisting of bone overlaid with enamel.

Gill arch—the bony support to which the gill filaments and gill rakers are attached.

Gill filaments—the slender, delicate fringe-like structure composing the gill.

Gill rakers—spine-like structures attached to the gill arches and serving to strain food from the water. The formula 15+25, indicates 15 rakers on the upper limb of the arch and 25 on the lower.

Heterocercal—having the vertebral column terminating in the upper lobe of the tail fin, which is usually longer than the lower lobe.

Homocercal—referring to a caudal fin with the upper and lower lobes of equal, or nearly equal, length.

Insertion (of fin)—the posterior end of the base of a fin.

Isthmus—the narrow portion between the bones of the lower jaw and the gill chambers.

Larva (pl. *larvæ*)—the immature stage of an animal which eventually undergoes certain structural changes in becoming adult.

Lateral—of the side.

Lateral line—a series of pores along the side of a fish's body opening into sensory organs located beneath the scales.

Mandible—the lower jaw.

Maxillary—the second and usually the larger of the two bones forming the upper jaw.

Median—situated on the vertical axis of the body.

Myotome—each muscle bundle of a series.

Opercle or operculum—the gill cover.

Origin (of fin)—the anterior end of the base of a fin.

Ovaries—the female reproductive organs which give rise to the eggs.

Palatines—a pair of bones on the roof of the mouth, extending outward and backward from the head of the vomer, sometimes bearing small teeth.

Papilla (pl. *papillæ*)—a small fleshy projection, sometimes tubular.

Pectoral fin—the paired fin attached to the shoulder girdle.

Pelvic fin—the paired fin attached to the pelvic girdle.

Pharyngeal teeth—bony structures in the pharynx for the grinding of food. (The formula 2,4–4,2 means 2 teeth on the outer row on the left and right side and 4 teeth on the inner row of left and right side).

Pharynx—that part between the mouth cavity and the œsophagus.

Plankton—minute animal and plant organisms floating free or weakly swimming in the water.

Posterior—behind.

Premaxillary—the first of two bones, on either side of the mid-line of the upper jaw, immediately in front of the nasal bones, sometimes overlapping the maxillary bone laterally.

Preopercular spine—a posterior projection from the front membrane bone of the gill cover.

Protractile—capable of being thrust out or extended forward.

Pyloric cæcum (pl. *cæca*)—a finger-like process attached to the intestine where it leaves the stomach.

Ray (of a fin)—the support to the fin membranes (includes both segmented soft ray and unsegmented spiny ray).

Retrorse—bent backward or downward.

Scute—a bony or horny plate.

Subterminal (mouth)—almost at the anterior tip of the head.

Spine (of a fin)—the unsegmented supports of the fin membranes regardless of whether or not they are stiff.

Striæ—fine lines or ridges, as on the operculum of some fishes.

Tail—the part of the body posterior to the body cavity; in most fishes this is applied to the caudal peduncle and fin inclusive.

Terete—round in cross-section.

Testes—the male reproductive organs which give rise to sperms.

Thoracic—in the region of the thorax or "chest."

Ventral fin—the paired fin attached to the pelvic girdle.

Ventrolateral—on the side above the belly.

Vermiculations—wavy or worm-like markings.

Vomer—the bone in the roof of the mouth toward the front.

Weberian ossicles—a series of four small bones connecting the air-bladder with the inner ear to form an auditory and hydrostatic organ.

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APPENDIX.

Maintenance of an Aquarium.

Several of our native and introduced fishes thrive well in aquaria and therefore may be used in the home as pets and also in the classroom as a means of demonstrating biological principles. Fishes which may be maintained successfully in captivity include the common stickleback and most of the minnows among the native species, and the catfish, sunfish, crappie, and perch among the non-native species. Of these, the catfish and sunfish are the most satisfactory, since they withstand best the crowded conditions usually present in a tank.

The use of game fishes such as trout and salmon fingerlings should be avoided. Fishes of this group do not thrive well in aquaria, and moreover game regulations prohibit their removal from lakes and streams except by special permit. It should also be noted that it is unlawful to transfer fishes from one body of water to another without authority from the office of the Game Commission. Special care should be taken, therefore, to see that aquarium fishes are placed back in the lake or stream from whence they came.

In setting up an aquarium, the following brief suggestions may be helpful:—

(1) Select a rectangular glass tank (for best visibility), such as a battery jar or a pneumatic trough or one made of glass set in a metal frame.

(2) Place the tank where it will receive strong diffused daylight, such as in a north or east window. A few hours direct sunlight will do no harm but is not necessary.

(3) Clean the tank thoroughly and place 1 to 2 inches of clean sand or fine gravel on the bottom.

(4) Partly fill with water by pouring onto a sheet of paper. (In cities where water is chlorinated, it is advisable to allow the tap-water to stand overnight before use.)

(5) Place a few water plants along the back and sides by pressing the roots into the sand with the aid of a stick.

(6) Fill tank within an inch or two of the top and cover with a sheet of glass to keep out dust and dirt and to cut down evaporation.

(7) Place only a few fish, snails, aquatic insect larvæ, etc., in the aquarium, avoiding predacious forms, which should be kept by themselves.

(8) Feed sparingly; remove all surplus food and dead inmates immediately to avoid fouling the water.

A little experimenting will show how many plants and how many animals can be successfully maintained in a tank of given size; when the numbers are properly adjusted and the water remains clear, the aquarium is said to be "balanced." When this condition is attained, a tank will need little or no attention for long periods except for occasional cleaning. The water should be changed only in the event of serious fouling. Further details in aquarium management may be obtained by writing the General Biological Supply House, 761–763 East 69th Place, Chicago, Ill., and asking for Turtox Service Leaflets, Nos. 5, 23, and 48, or by consulting books in the local library.

Collection and Preservation of Specimens.

Much is yet to be learned concerning the distribution and life-histories of the various species of fresh-water fishes found within our Province, and in order to increase this knowledge, it is first necessary to gather specimens upon which to base our knowledge. For the benefit of those who may be interested in this field of study, the following information is offered.

Before intensive collecting is begun, a permit should be obtained either through the office of the Game Commission, Vancouver, or through the Provincial Museum, Victoria. Such permits are granted only to responsible persons wishing to collect for scientific purposes.

Specimens may be collected by angling or by the use of beach seines, gill-nets, dip-nets, or traps, depending upon the fishes desired and the type of water or shore concerned. In relatively shallow water, free of snags and dense weed-growth, a seine is very effective in capturing many species of fish. In other situations gill-nets of differing sizes of mesh and set at varying depths are indispensable. In streams, particularly at times of migration, traps may be used to great advantage. Whatever collection method is used, care should be taken not to damage the fish, so that its value as a scientific specimen will not be impaired. Unwanted fish should be released

unharmed, except harmful species such as carp, suckers, and squawfish, which should be destroyed.

The most satisfactory general preservative is formalin, diluted to make a 10-per-cent. solution (one part of commercial formalin to nine parts of water). This preservative has the advantage of being easily procured and inexpensive, but is disagreeable to handle and tends to harden the specimens. Grain-alcohol or wood-alcohol, diluted to about 85 per cent. (eight parts of commercial alcohol to one part of water), makes an excellent preserving fluid, but is considerably more expensive and tends to destroy pigmentation more rapidly than formalin. Whichever preserving fluid is used, some of the liquid should be introduced into the body-cavity, in all but the smallest specimens, by injecting with a hypodermic needle or by cutting a slit in the body-wall. A label bearing complete data in pencil, such as place and date of capture, collector's name, field number, etc., should be firmly attached to each specimen. Specimens should be stored by immersing them completely in jars or crocks equipped with tight-fitting lids to prevent loss of preservative by evaporation.

When identifications are uncertain, the fish in question may be sent for examination either to the Provincial Museum, Victoria, or to the Department of Zoology, University of British Columbia, Vancouver.

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